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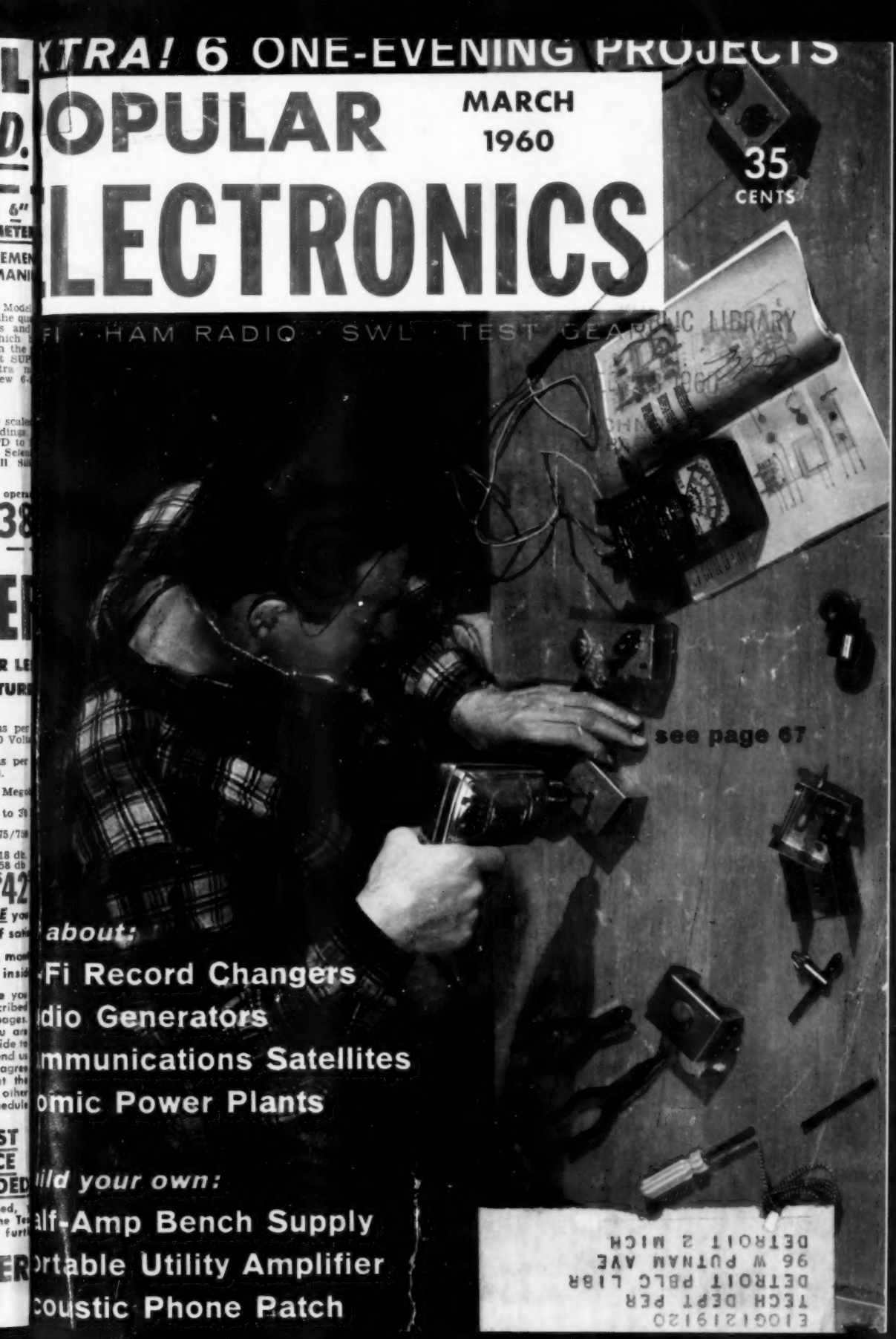

see page 67

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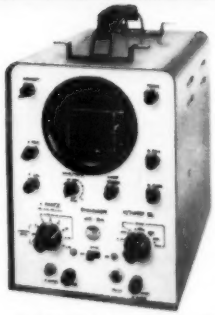

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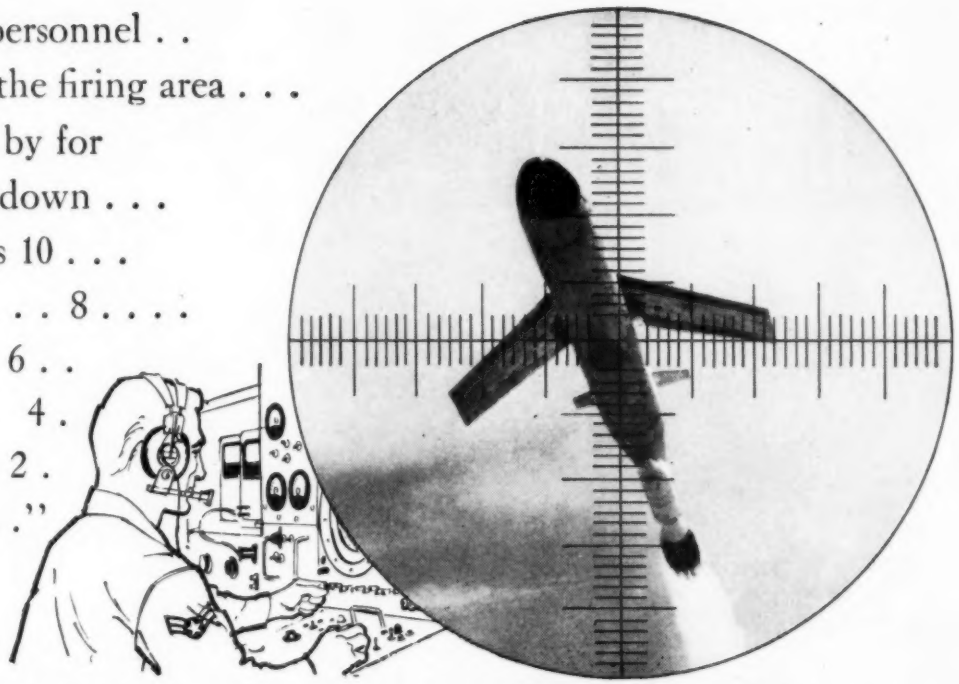

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POPULAR ELECTRONICS

MARCH 1960

VOLUME 12 NUMBER 3

ZIFF-DAVIS PUBLISHING COMPANY

Special Construction Feature

Six One-Evening Electronic Projects.....*Louis E. Garner, Jr.* 67
1: A First-Project Receiver..... 68
2: D. C. Control Unit..... 70
3: Combination Checker..... 72
4: Hi-Fi Speaker Crossover..... 74
5: Fuse Saver..... 76
6: Broadcast-Band Wave Trap..... 78
• Construction Tips for the Beginner..... 79

Other Electronic Construction Projects

Half-Amp Variable Transistor Bench Supply.....*Eugene Richardson* 45
Electronic Music Box.....*E. G. Louis* 63
Portable Utility Amplifier.....*Luis Vicens* 83
Unusual Uses of Potentiometers.....*Kenneth Richardson* 92
Transistorized Driver Alarm.....*Dave Gordon* 98

Audio and High Fidelity

Unusual Tape Recorder..... 48
Add a Tuning Meter to Your FM Receiver.....*Lou Gordon* 53
Inside the Hi-Fi Record Changer.....*Joseph Marshall* 55
Test Instruments—Audio Generator (Part 3).....*Larry Klein* 86

Amateur and SWL

Acoustic Phone Patch.....*J. C. Fischesser, W4FMW* 59
Understanding Ham Lingo.....*Bill Walker, K2RUK* 89
Roundup of Citizens Band Transceivers..... 100
Short-Wave Monitor Registration..... 129

Electronic Features and New Developments

Communications Satellites—Key to World-Wide TV.....*Ken Gilmore* 41
Nuclear Kilowatts for You.....*Paul Janvier* 49
Experimental Wind-Power Generator..... 62
Electronic Baby-Sitter.....*Harry J. Miller* 65
The Short-Circuited Enthusiast.....*Carl Kohler and Jim Williams* 90
Electronics in the News..... 105

Departments

Notes from the Editor.....*Oliver Read, W1ETI* 8
Letters from Our Readers..... 12
POP'tronics Bookshelf..... 18
Tips and Techniques..... 24
New Products..... 30
Short-Wave Report.....*Hank Bennett, W2PNA* 66
Transistor Topics.....*Lou Garner* 93
Across the Ham Bands.....*Herb S. Brier, W9EGQ* 95
Carl and Jerry.....*John T. Frye, W9EGV* 106
On the Citizens Band.....*Tom Kneitel, 2W1965* 134

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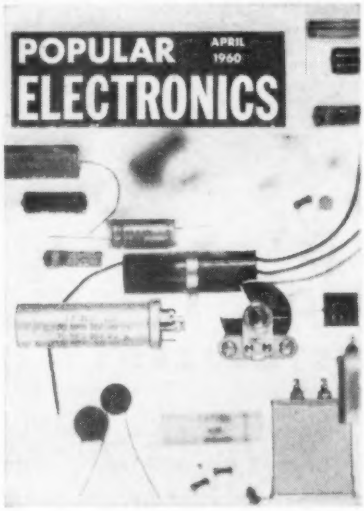

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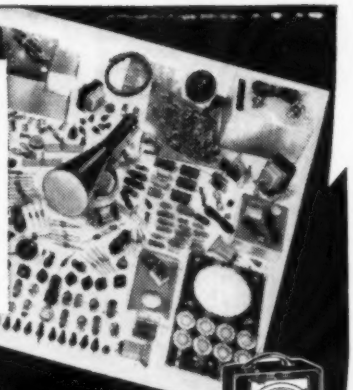

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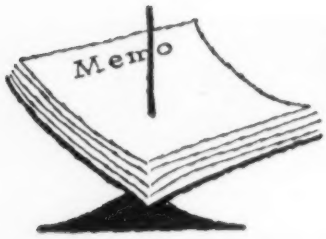

Notes from the Editor

SPECIAL SECTION. The readers of POPULAR ELECTRONICS form the largest group of electronics hobbyists in the world. Over 300,000 strong, they include service technicians, engineers, students, doctors, lawyers, and people from every walk of life. They spend millions of dollars each year for tubes, transistors, resistors, and capacitors, and other parts that are needed for building the construction projects which are presented in each issue of POPULAR ELECTRONICS.

Every month we try to serve up an interesting selection of projects to keep this group of people happy, but this month we have something that is really quite special. "Six One-Evening Projects," which begins on page 67, is just what its title implies—a collection of simple construction projects which can be built quickly and easily. Although anyone with an interest in electronics is almost sure to want to build at least one of these useful gadgets, it should be pointed out that here is an especially fine opportunity for the newcomer to get started in electronic construction—to "cut his teeth" on these projects.

In any case, whether you are a beginner or an old-timer, I would appreciate your letting me know what you think of the special section and if you would like to see similar sections in future issues.

STEREO CONFUSION. The advertising departments of some of the country's largest stereo console manufacturers have been engaged in a furious battle of words, with some companies touting their "3-channel" stereo systems, and with other companies crying "foul" and complaining that this is misleading advertising. Of course, as we all know, all commercial stereo material consists of only two channels. What the "3-channel" name usually means is that a frequency-dividing network sends the lows from both channels to a common bass amplifier and the highs to separate treble amplifiers. It is clear that to the average consumer the designation of a tri-amplifier system or a 3-speaker system as a "3-channel" system is misleading—suggesting, of course, that somehow or other three stereo tracks (instead of two) are being used.

As a result of this confusing situation, the National Better Business Bureau has recently appealed to the manufacturers of stereo equipment to use accurate terminology in their advertising. Let us hope that this situation will be quickly resolved.

Oliver Read

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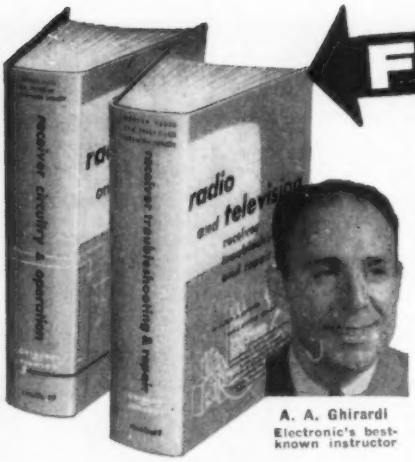

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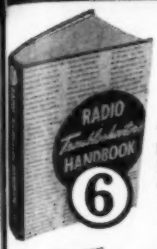

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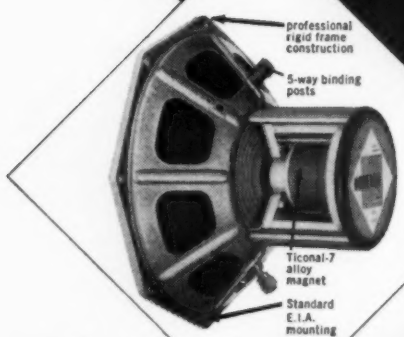

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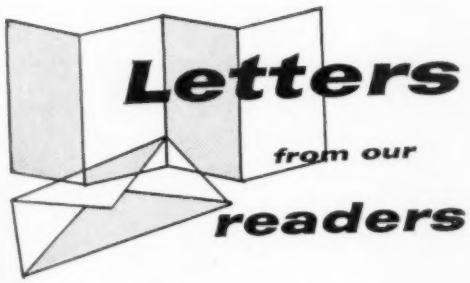

Suppressing Car Radio Noise

■ After reading "Take the Noise Out of Your Car Radio" by Jack Darr (December 1959 issue), I felt that there was one very important point which was not touched upon.

The author suggested that a special 10,000-ohm resistance wire be connected from the coil to the distributor. Then, Mr. Darr went on to say, for a really stubborn case of spark plug noise, spark plug suppressors could be put on the spark plugs.

I think it should be mentioned that inserting this equipment in the ignition system would slow

down the spark, thus tending to put the engine out of time. This might have no noticeable effect, but then again it might make a world of difference in the car's performance.

To anybody installing this equipment on a car, I would strongly recommend having the engine re-timed for best performance.

FRED DORFFELD, WPE7NU
Bellingham, Wash.

Canadian CB?

■ I would like to know if there are more Canadians like myself who would be interested in a Canadian Citizens Band. If so, they are invited to write me so that we can try to organize some action on this matter.

LARRY D. WHITING
L.W. Electronics
Strathroy, Ont., Canada

Souped-Up S-38E

■ I would like to express my appreciation for the article entitled "Soup Up Your AC-DC Short-Wave Receiver" which appeared in the December 1959 issue. I built the regeneration control as described (except that I used a 10-watt resistor) and wired it into my S-38E. It improved the selectivity and sensitivity far beyond my expecta-

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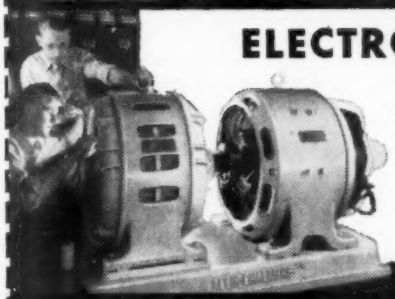

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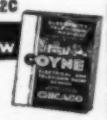

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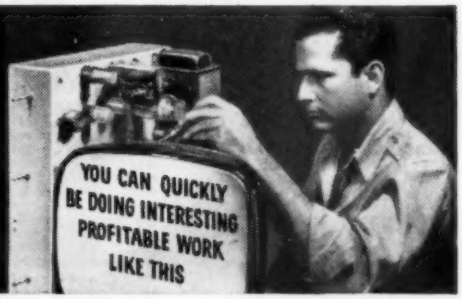

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Letters

(*Continued from page* 12)

tions. I highly recommend this modification to others using this type of receiver.

STANFORD L. MCDONALD
Lincoln, Neb.

DX CB Transmission

■ Occasionally I pass the time here on Guam Island by listening in on the ham bands. As I was flipping through the Citizens Band frequencies on

Sunday, December 13, I was quite astonished to pick up a transmission between 21WØ217 and 21WØ1Ø5, both in Hawaii. This seemed extraordinary considering the low power of Citizens Band equipment and the fact that we are 4000 miles from Hawaii. I could hear every word from Ø1Ø5 but had trouble picking up Ø217. My S-meter registered an S-3 with Ø1Ø5.

T/SGT. R. R. MILLIGAN
3960th CSG, AFSSO, Box 169
APO 334, San Francisco, Calif.

Einstein Defenders

■ I was shocked when I read the sweeping statements of Mr. Henry J. Wett in the December *Letters from Our Readers* column. I think Mr. Wett had better study some of Einstein's writings so he'll know what he's talking about. Judging from his statements, I don't think he knows what the theory of relativity is. Nor is he the first to propose electricity as the basis of all things.

By the way, Einstein's theory of relativity explains the motion of the perihelion of Mercury. Does Mr. Wett's?

VERNON RAAFLAUB
Magnetawan, Ont., Canada

■ In reference to Mr. Henry J. Wett's letter, I disagree with everything but one phrase: "You may think of me as a crackpot." I most certainly do.

As for your magazine, keep up the great work, but a little less on the hi-fi, please.

GARY EDELMAN
Bronx, N. Y.

Music to Our Ears

■ For gosh sakes, don't take any suggestions seriously that would have you eliminate hi-fi for

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1B3GT	3AL5	5V4G	6AU5GT	6BQ6GT	6D6	6SG7	7B7	12AQ5	12D4	25Z6GT	57
1C6	3BC5	5V6GT	6AU6	6BQ7	6DE6	6SH7	7B8	12AT6	12F5	26	58
1C7	3BN6	5X8	6AU8	6BR8	6DG6GT	6SJ7	7C4	12AT7	12K7	27	71A
1F4	3BZ6	5Y3	6AV5GT	6BS8	6DQ6	6SK7	7C5	12AU6	12L6	35	75
1F5	3CB6	6A6	6AV6	6BY5G	6F5	6SL7	7C6	12AU7	12Q7	35A5	76
1G4	3Q4	6AB4	6AW8	6BZ6	6F6	6SQ7	7C7	12AV6	12SA7	35B5	77
1H5GT	3S4	6AC7	6AX4GT	6BZ7	6H6	6SR7	7E5	12AV7	12SJ7	35C5	78
1L4	3V4	6AF4	6AX5GT	6C4	6J4	6T4	7E6	12AX4GT	12SK7	35W4	80
1L6	4BQ7A	6AG5	6B8	6CB6	6J5	6U8	7E7	12AX7	12SN7GT	35Z5	84/6Z4
1N5GT	4B58	6AH4GT	6BA6	6CD6G	6J6	6V6GT	7F7	12AZ7	12SQ7	36	117Z3
1R5	4BZ7	6AH6	6BC5	6CF6	6J7	6W6GT	7F8	12B4	12V6GT	38	
1S5	4CB6	6AK5	6BC8	6CG7	6K6GT	6X4	7G7	12BA6	12W6GT	39/44	
1T4	5AM8	6AL5	6BD6	6CH8	6K7	6X5GT	7H7	12BA7	12X4	41	
1U4	5AN8	6AM8	6BE6	6CL6	6N7	6X8	7N7	12BD6	14A7/12B7		
1U5	5AT8	6AN8	6BF5	6CM6	6Q7	6Y6G	7Q7	12BE6	14B6	42	
1V2	5AV8	6AQ5	6BG6G	6CM7	6S4	7A4/XXL	7S7	12BF6	14Q7	43	
1X2	5AZ4	6AQ6	6BH6	6CN7	6S7	7A5	7X6	12BH7	19	45	
2AF4	5BR8	6AQ7	6BJ6	6CQ8	6S8GT	7A6	7X7	12BQ6	19AU4GT	50A5	
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T. E. Spence, Greensboro, N. C.

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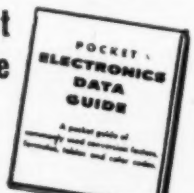

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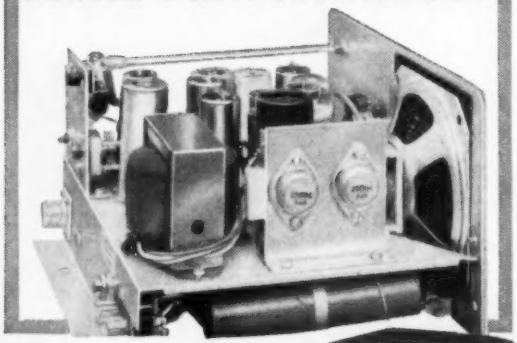

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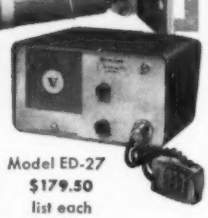

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Letters

(*Continued from page* 14)

another branch of electronics. I think POPULAR ELECTRONICS is the best in the field because it gives the reader a balanced diet of all that is going on in this great industry.

Every branch of electronics has its own publications and people who want more on a specific area should subscribe to one of them. Meanwhile, I hope POPULAR ELECTRONICS will continue its excellent presentations of everything from ham to hi-fi, plus current scientific developments.

ROGER W. BERGER
Coronado, Calif.

Receiver Modulation?

■ I would be very interested to know how or why a Heath AR-3 receiver is modulated by a hi-fi amplifier as mentioned in the caption accompanying the article on modulating a transmitter in the January issue (page 120). The article is clear, but the caption is misleading.

Actually, I think POP'tronics is tops in its field. I really enjoyed the construction article on the 15-meter beam antenna in the same issue. I became addicted to your magazine in March of 1956, and you are largely responsible for my getting my ham license.

TED WURZBURG, WV2JIZ
Chappaqua, N. Y.

Reader Wurzburg is right; the caption was wrong. There is obviously not much point in modulating a receiver.

Electronic Pen Pals Wanted

■ I am 17 years old and am greatly interested in electronic experimenting. I would like to correspond with someone (either a boy or a girl) about my age who is also interested in electronics.

GEORGE LODENQUAI
Lluidas Vale P.O.
St. Catherine
Jamaica, B.W.I.

New Construction Fan

■ I would like to compliment you on your wonderful publication. It is the only electronics magazine I have found that includes material for a neophyte such as myself. I am thinking primarily of the article by Don Stoner in the September issue on building a transistorized stereo tape preamplifier. I have built two of these units and have found them to be, as Mr. Stoner stated, "clean as a whistle."

Although I'm no stranger to electronics, having been employed by the Bell Telephone Company for the past eighteen years, this was the first time I had ever built anything. Now I'm afraid I've gotten the "fever." Have you ever published a schematic for a transistorized recording preamplifier?

JAMES R. COX
Springfield, Ill.

Sorry, but we've never published a circuit for a tape recording preamplifier. Your best bet is one of the commercially available units. Many thanks for the kind words. —30—

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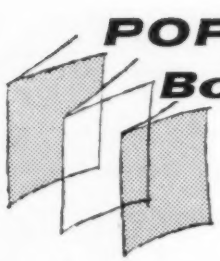

"FROM TINFOIL TO STEREO: THE EVOLUTION OF THE PHONOGRAPH" by Oliver Read and Walter Welch. Published by Howard W. Sams and Co., Inc., 2201 East 46th St., Indianapolis 5, Ind. 576 pages. $9.95.

When the name of Thomas Edison is mentioned, few images come so quickly to mind as the one of him shouting "Mary had a little lamb" into his newly made tinfoil phonograph. Edison was, of course, the greatest inventor of his time, and he received the adulation usually afforded only to royalty. But he had many competitors who challenged his leadership in the field of invention and who were a thorn in his side commercially.

This lengthy book on the evolution of the phonograph relates not only the progress of the different mechanical designs from the beginning through electrical recordings but also the fascinating story of the pioneering recording companies fighting one another bitterly—hardly hesitating to pirate designs and betray trusts. It is the most authentic, complete, and detailed book on the phonograph yet to appear and it will probably become the definitive work on the subject. Especially valuable is a chart showing the corporate geneology of record companies.

Recommended as an entertaining and valuable reference book for those interested in the backgrounds of present-day audio techniques and as a standard reference work for all manufacturers of records and recording and reproducing equipment.

"REALM OF NUMBERS" by Dr. Isaac Asimov. Published by Houghton Mifflin Co., 2 Park St., Boston, Mass. 200 pages. $2.75.

Dr. Asimov is a chemist and well-known science writer who knows how to put across the basic ideas of mathematics. This is not a textbook but rather the story of the de-

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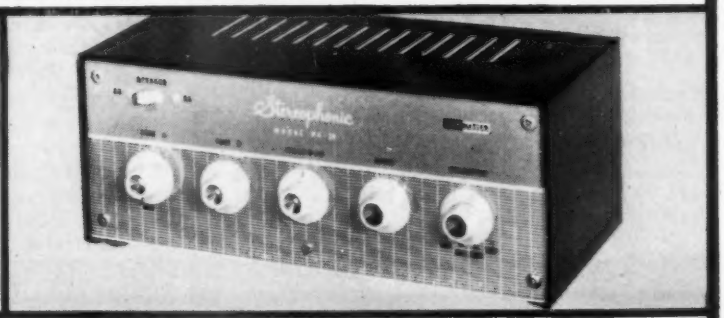

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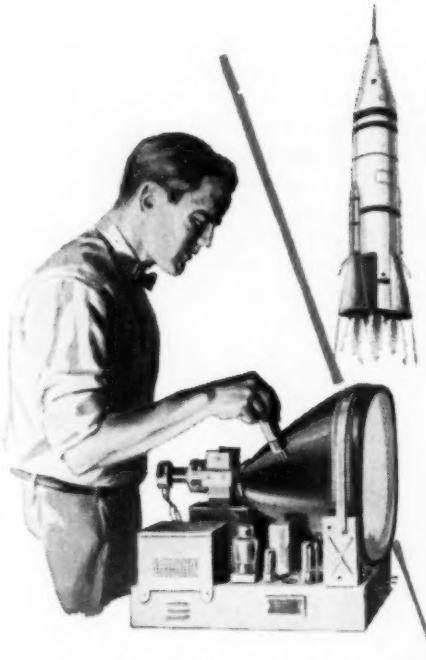

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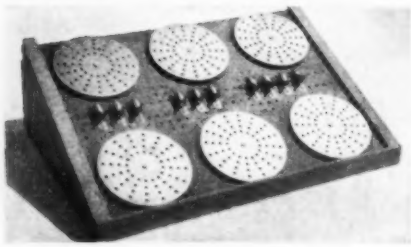

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Bookshelf

(*Continued from page* 18)

velopment of the number concepts which underlie mathematical thinking. The book begins with a discussion of finger counting and the sense of number shown by men and by animals. From there it goes on to cover the meaning of zero, fractions, number systems, logarithms, and infinity. But don't let this array of topics scare you away; to understand Dr. Asimov's tale of numbers you need only an understanding of elementary arithmetic. This is an interesting book and should stimulate interest in a further study of mathematics.

"COMPUTERS AND HOW THEY WORK" by James D. Fahnestock. Published by Ziff-Davis Publishing Co., One Park Ave., New York 16, N. Y. 228 pages. $4.95.

No doubt many people would like to know how computers work but feel that the subject is somewhat beyond them. Here is a book with such a logical approach to the subject that it should be understandable to anyone—even to a person without a knowledge of electronics. The first part is devoted to an examination of the logic that a computer must use in order to "think." Then the author goes into the mechanics and electronics of computers—covering such subjects as memory systems, magnetic recorders, input-output systems, etc.

This book is recommended as a very readable and easy-to-follow introduction to the basics of computers. If you've been feeling "out of it" when the subject of computers has come up, this is the answer to your problem.

"TV DISTRIBUTION SYSTEM HANDBOOK" published by Jerrold Electronics Corp., 15th and Lehigh Ave., Philadelphia 2, Pa. 48 pages. Soft cover. $1.00.

This booklet contains 150 layout charts which diagram practically every existing type of TV distribution system. An unusual feature makes the booklet very easy to use: the pages are split, allowing the reader to match any kind of head-end system to various distribution systems. Also included is practical information on calculating layouts for coaxial cable systems, an explanation of the decibel and how to use it, tips on

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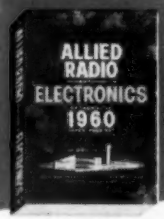

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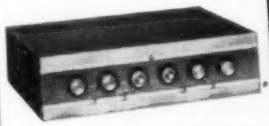

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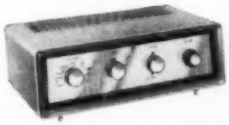

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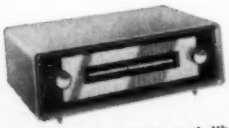

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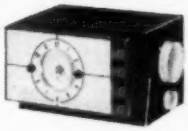

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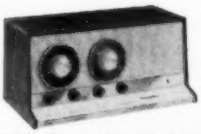

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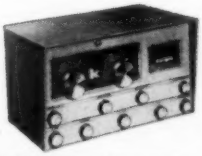

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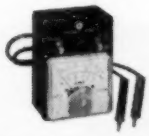

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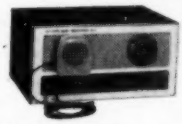

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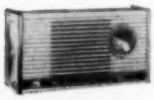

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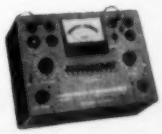

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Bookshelf (*Continued from page* 20)

erecting antennas, data on coaxial cable and channel frequencies, etc. Highly recommended for service technicians who install and maintain TV distribution systems.

"VACUUM TUBE CHARACTERISTICS" edited by Dr. A. Schure. Published by John F. Rider Publisher, Inc., 116 West 14th St., New York 11, N. Y. 96 pages. Soft cover $1.80.

An extremely comprehensive discussion of vacuum-tube constants and characteristics, this book is written at the intermediate level. It covers electron emission, diodes, triodes, multi-grid tubes, and special-purpose tubes; and review questions appear at the end of each chapter.

Miscellaneous Literature

Complete construction plans for building six different enclosures suitable for use with Audax speakers are featured in a 12-page booklet entitled "Build Your Own Audax Paraflex Speaker System." A copy can be obtained by mailing 25 cents to Audax, Inc., Dept. 320, 38-19 108th St., Corona 68, N. Y.

A 64-page catalog has just been announced by Zalytron Tube Corp., Dept. P2, 220 West 42nd St., New York 36, N. Y. In addition to listing the Zalytron line of receiving tubes, Catalog No. 160 includes many items for use in electronic experimentation.

Detailed information on toolroom specialties will be found in Scherr-Tumico's new 96-page catalog of precision measuring tools and instruments. It is available from Scherr-Tumico, 200 Lafayette St., New York 12, N. Y.

A four-page glossary of tape recording terms called "99 Tape Recording Terms" is available from Minnesota Mining and Manufacturing Co., Dept. E9-520, 900 Bush Ave., St. Paul, Minn. Although this booklet is intended primarily for the amateur, the professional recordist should also find it valuable for reference purposes. —30—

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The new PACO Model SA-40 offers you greater reserve power capacity than any other preamp-amplifier in its category. Its exceptional circuit design assures highly stable performance with extremely low distortion. And...the SA-40 provides maximum flexibility in *any* stereophonic high fidelity system present or contemplated.

outstanding specifications:
POWER OUTPUT: 20 watts per channel, 40 watts total
RESPONSE: 30 cps to 90 Kc ± 1 db
DISTORTION:
Harmonic — less than .2% at 20 watts per channel
less than .1% at 10 watts per channel
Intermodulation — less than 1% at full rated output
FRONT PANEL CONTROLS: 14 controls including separate bass and treble controls
POWER SUPPLY: Silicon diode, low impedance for minimum distortion
EXTERNAL DESIGN: gold and satin black hooded case with panel illumination and satin gold panel

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Electro-Voice® NEW MAGNERAMIC* 31 MD7

has ceramic elements!

For more than 35 years, Electro-Voice has been a leader in the development and manufacture of dynamic microphones and loudspeakers. Why then, with this extensive experience in designing and producing electro-magnetic devices, is Electro-Voice introducing the new Magneramic 31 Series stereo cartridge using ceramic elements?

The reason is that Electro-Voice is genuinely convinced that a precision ceramic cartridge is the finest type that can be made today . . . definitely superior to the magnetic type. The superiority of the Magneramic 31 is demonstrated in these three areas.

GREATER FLEXIBILITY — The 31 Series cartridge will operate perfectly at any stylus pressure from 2 to 20 grams. The same stylus assembly can be used for operation on both turntable and record changers; performance need not be compromised by using a special, stiff stylus assembly for record changers. Record wear is the only criterion in setting stylus pressure — cartridge operation is not affected. Thus, when converting from a changer to a turntable, or vice versa, replacement of the stylus assembly is not necessary when using the Magneramic 31.

HIGHER OUTPUT — Along with the trend toward less efficient speaker systems, more amplifier power has become a necessity. While most stereo amplifiers are now designed with input sensitivities to match the typical 5-millivolt output of magnetic stereo cartridges, nearly all monaural amplifiers were designed for at least 8-millivolt input. These cannot be driven to full output with a magnetic stereo cartridge. The Magneramic 31 develops a full 8-millivolt output and couples directly into any "magnetic" preamp unit. This higher output should especially be considered by those planning conversion to stereo utilizing existent monaural amplifiers.

FREEDOM FROM HUM — The increased amplifier gain required to satisfactorily drive low-efficiency speakers coupled with decreased cartridge output has significantly increased system hum problems. Also, conventional methods of hum elimination used in monaural magnetic cartridges become difficult or impossible to apply to stereo magnetics. The Magneramic 31 completely eliminates these problems — it is non-inductive and has adequate output.

The Electro-Voice Magneramic 31 MD7 cartridge directly replaces any monophonic or stereophonic magnetic cartridge now on the market. It feeds into the preamp input-jack specified for magnetic cartridges and does not require adaptors or circuit modifications.

SPECIFICATIONS — MAGNERAMIC 31 MD7

Response Range: 20 to 15,000 cps ± 2 db
Compliance, Vertical: 3.5 x 10^{-6} cm/dyne
Compliance, Lateral: 3.5 x 10^{-6} cm/dyne
Isolation: 28 db @ 1000 cycles
Tracking Force: 2 to 4 grams in transcription arms
4 to 6 grams in changer arms
Styli: .7 mil diamond
Output: 8 millivolts
Recommended Load: 22,000 to 47,000 ohms (Magnetic phono inputs)
Elements: 2, Lead Zirconium Titanate (Ceramic)
Weight: 8 grams
Terminals: 4, standard .050" connectors
Mounting Centers: ½" and $^{5}/_{16}$" fits both
Audiophile Net: $24.00

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BUCHANAN, MICHIGAN

Tips and Techniques

DIMMING PANEL LIGHTS

Panel lights on an oscilloscope are often too bright for use in the dark because they cause glare and make it difficult to see the image on the tube. You can reduce panel-light glare by removing the jewel from the lamp and gluing a thin piece of dark cloth to the inside of it. The same technique can be used with other pieces of equipment as well.—*Bob Culter, Oswego, Ore.*

PLASTIC PEN PROBE

You can build an inexpensive probe from a plastic pen that has a plunger on top. Simply remove the plunger pin, any internal metal spring, and the ink cartridge. Heat the pocket clip with a soldering iron and pull it off with a pair of pliers. Cut off the ink container from the ball point assembly. Then tin the end of the ball point assembly, solder a wire to it, and replace it in the pen. Fill the lower half of the pen with plaster of Paris and feed the free

end of the lead through the top of the pen. And there's your probe.—*Arthur C. Nelson, Minneapolis, Minn.*

HARDWARE SORTING TRAYS

The trouble with storing hardware and small parts in a glass jar is that you have to dump out the whole jar to get at one particular part. If the contents of a jar are

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You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 16 Receiver, Transmitter, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

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The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble-shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

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Included in the "Edu-Kit" course are sixteen Receiver, Transmitter, Code Oscillator, Signal Tracer, and Signal Injector circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 16 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

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- PRINTED CIRCUITRY

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

J. Stataitis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself, I was ready to spend $240 for a Course, but I found your ad and sent for your Kit."

FROM OUR MAIL BAG

Ben Valerio, P. O. Box 21, Magna, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Troubleshooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

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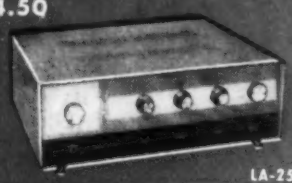

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50 WATT INTEGRATED STEREO AMPLIFIER

● RESPONSE 17-21,000 CPS ± 1 DB (at normal listening level) ● UNIQUE "BLEND" CONTROL ● PREMIUM EL86 OUTPUT TUBES ● 50 WATTS MONAURAL—25 WATTS EACH STEREO CHANNEL ● CLUTCH-OPERATED VOLUME CONTROL ● SEPARATE BASS & TREBLE CONTROLS

A completely new stereo high fidelity amplifier with a high quality of reproduction, remarkable versatility and new distinctive styling. Full range of controls include a unique "blend" control for continuously variable channel separation—from full monaural to full stereo, 4-position Selector, Mode, Loudness and Phasing switches plus outputs for 4, 8 or 16 ohm speakers. Harmonic distortion less than 0.25%, IM distortion less than 1%. Hum and Noise 74 db below full output. Assembly is simple—no special skills or tools required. Complete with deluxe cabinet and legs, all parts, tubes and detailed instruction manual. Shpg. wt., 26 lbs.

KT-250AWX Stereo Amplifier Kit ..... 5.00 Down ..... Net 74.50
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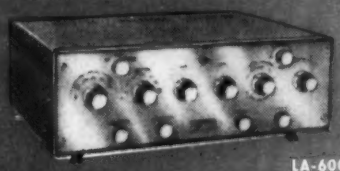
KT-600 IN KIT FORM
79.50



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● RESPONSE 5-40,000 CPS ± 1 DB ● UNIQUE STEREO & MONAURAL CONTROL FEATURES ● PRECISE "NULL" BALANCING SYSTEM ● CONCENTRIC INPUT LEVEL CONTROLS

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KT-600 WX Stereo Preamplifier Kit ..... 5.00 Down ... Net 79.50
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KT-310 IN KIT FORM
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72.50

STEREO/MONAURAL POWER AMPLIFIER KIT

● 36 WATT STEREO AMPLIFIER—18 WATTS EACH CHANNEL ● EMPLOYS 4 PREMIUM-TYPE 7189 TUBES ● 2 PRINTED CIRCUIT BOARDS FOR SIMPLIFIED WIRING ● RESPONSE BETTER THAN 35-30,000 CPS ± ½ DB AT 18 WATTS ● LESS THAN 1% HARMONIC OR IM DISTORTION

A superb basic stereo amplifier in easy-to-build kit form. Unit may be used with a stereo preamplifier to provide two 18 watt stereo channels or, at the flick of a switch, as a fine 36 watt monaural amplifier. Controls include 2 input volume controls, Channel Reverse switch and Monaural-Stereo switch. Dual outputs for 4, 8, 16 or 32 ohm speakers. Input sensitivity .45 volts per channel for full output. Tubes are 2-6AN8, 4-7189, GZ-34 rectifier. Sizes 10-9/16" d x 5¼" h x 13¼" w. Complete kit with cage, all parts, tubes and detailed instruction manual. wt., 22 lbs.

KT-310 WX Stereo Power Amplifier Kit ..... 2.00 Down .. Net 47.50
LA-310 WX Stereo Power Amplifier, wired and tested ..... 5.00 Down .. Net 72.50

KT-500 IN KIT FORM
74.50

LT-50
COMPLETELY WIRED
124.50

FM-AM STEREO TUNER KIT

● 11 Tubes (4 dual-purpose) + Tuning Eye + Selenium rectifier provide 17 tube performance ● Multiplex Output for new Stereo FM ● Armstrong Circuit with Dual Limiters and Foster-Seeley Discriminator ● Extreme Sensitivity and Wide Frequency Response.

A precision engineered, highly stable tuner—perfect for lifelike stereo FM-AM broadcast reception, FM reception and/or AM reception. Features separate tuning and volume controls for AM and FM. Magic eye on AM and FM, plus automatic frequency control on FM for accurate tuning—stations are "locked" in. Other deluxe features include cathode follower outputs and 5-position Function Selector. Efficient, broadband circuitry on AM with built-in antenna. FM section features include 2 microvolts sensitivity for 30 db quieting, frequency response 20-20,000 cps ± ½ db and full 200 KC bandwidth. Two printed circuit boards make wiring simple—even for such a complex unit. Complete kit includes all parts, deluxe cabinet and detailed instruction manual. Size is 13¾"W x 10⅜"D x 4½"H. wt., 22 lbs.

KT-500WX FM-AM Stereo Tuner Kit ..... 5.00 Down ..... Net 74.50
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● 36-WATTS MONAURALLY—18 WATTS PER CHANNEL ● FREQUENCY RESPONSE 15-30,000 CPS ± 1 DB ● UNIQUE "BLEND" CONTROL ● CONCENTRIC CLUTCH-OPERATED VOLUME CONTROL ● DUAL CONCENTRIC BASS AND TREBLE CONTROLS ● 4-EL84 TUBES IN PUSH PULL

This exciting new amplifier kit combines dual preamplifiers and dual 18 watt power amplifiers on one compact chassis. Instant selection from monophonic to stereophonic is provided by the turn of a switch. An amazing new "blend" control gives continuously variable channel separation from full monophonic to full stereo. The concentric clutch-operated volume control offers independent or simultaneous level adjustments of both channels. Dual concentric bass and treble controls furnish 4 independent tonal adjustments. Harmonic distortion less than 0.15% at normal listening level. I.M distortion is less than .3%. Hum and noise 70 db below rated output. Complete with cage, legs and detailed instructions. Shpg. wt., 24 lbs.

KT-236AWX Stereo Amplifier Kit ..... 5.00 Down ..... Net 59.50

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LAFAYETTE LA-250A

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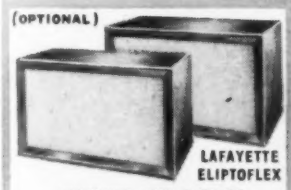
GARRARD RC121/11

NEW GE VR-227



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LAFAYETTE ELIPTOFLEX

FINISHED ON 4-SIDES

LAFAYETTE SK-58

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LAFAYETTE LA-250A 50-WATT AMPLIFIER	99.50
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HF-670WX Hi-Fi STEREO PHONO SYSTEM with choice of cartridge and mahogany, walnut or blond changer base (please specify)..... 5.00 Down ..... Net **184.50**

HF-671WX Same as HF-670, but with 2 Laf Eliptoflex Series Bookshelf Enclosures (please specify finish). Shpg. wt., 143 lbs..... 10.00 Down ..... Net **247.50**

HF-675WX Stereo AM-FM-Phono System. Same as HF-670 but including the Lafayette LT-50 stereo tuner. Shpg. wt., 85 lbs. ..... 10.00 Down ..... Net **299.50**

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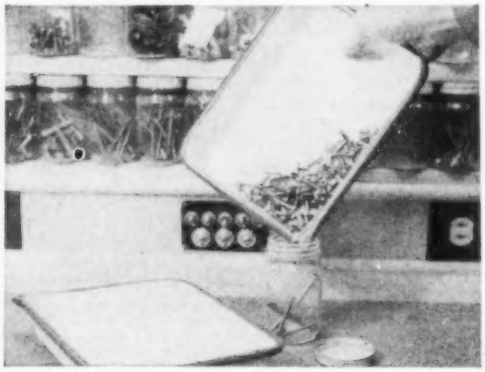
Tips

(*Continued from page 24*)

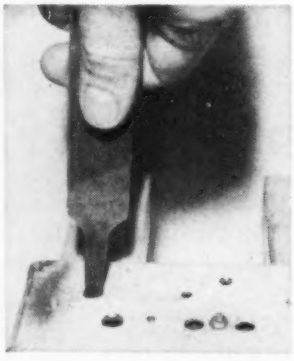
emptied into a photographic tray, the desired part can be selected and the rest returned to the jar with a minimum of effort. Such trays, available in many sizes, are



equipped with pouring lips that make them excellent for this purpose.—*D. Derek Verner, Tuckahoe, N. Y.*

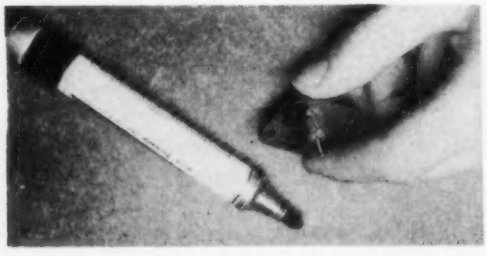
FILE TANG REAMS CHASSIS HOLE

If you don't have a reamer, you'll find that you can enlarge small chassis holes with the tang of a file. Although it won't cut as rapidly and easily as a reamer, it will leave quite a smooth edge. An octagonal-shaped tang works best.—*Joseph Carroll, B'klyn., N. Y.*



FELT TIP MARKING PEN

A felt tip pen is fine for marking the base and emitter pins on power transistors and



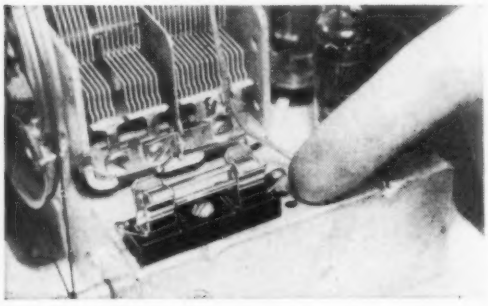
for marking reference symbol numbers on a chassis. Frequent reference to diagrams, pictorials, or parts lists becomes unnecessary and accidental burn out of polarized parts is prevented.—*Ronald S. Newbower, Gloversville, N. Y.*

BREADBOARD FROM WINDOW SCREEN

The newer plastic window screens can be used as breadboards. You just push the component leads through the holes in the screen. There are always plenty of mounting holes for parts and wiring is easy to trace from either side. Be careful when you solder the leads, though, so that the plastic does not melt.—*Bob Cutler, Oswego, Ore.*

KEEP SPARE FUSE HANDY

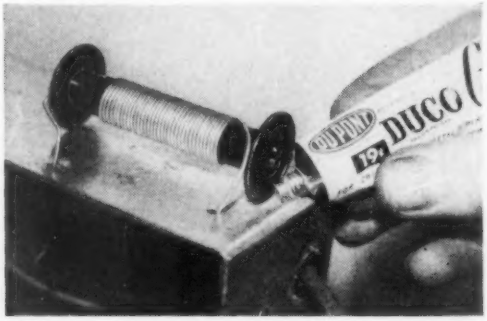
It's a good idea to store at least one spare fuse with each piece of fused electronics



gear. An ordinary fuse holder mounted on the chassis in a vacant spot makes a secure storage place for the spare. Extra pilot lamps can be stored in this kind of holder, too.—*James Clifford, Detroit, Mich.*

FILM-SPOOL COIL FORM

A plastic film spool makes a good low-loss coil form. Put the loose wire ends



through the slot in the coil for easy winding. The coil can either be mounted horizontally, as shown, with a couple of drops of cement on each flange, or vertically on one flange.—*John A. Comstock, Wellsboro, Pa.*

—30—

NEW! LAFAYETTE HE-15
CITIZENS BAND 11 METER
SUPERHETERODYNE TRANSCEIVER

Not Superregenerative but SUPERHET!

Unequaled Performance and Design . . The Greatest VALUE In The Citizens Band Field!

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- **Complete with Transmitting Crystal:** Removable front plate for easy accessability of crystals.
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- **Planetary Vernier Tuning:** Controls include 3 position function switch (transmit, receive, plus transmit with spring return) and squelch noise limiter control switch.
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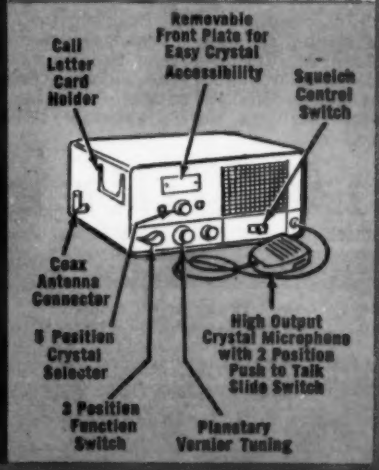
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Squelch Control Switch
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5 Position Crystal Selector
3 Position Function Switch
Planetary Vernier Tuning
High Output Crystal Microphone with 2 Position Push to Talk Slide Switch

JAMAICA, N. Y.	NEW YORK, N. Y.	BRONX, N. Y.	BOSTON, MASS.	NEWARK, N. J.	PLAINFIELD, N. J.
165-08 Liberty Ave.	100 6th Ave.	542 E. Fordham Rd.	110 Federal St.	24 Central Ave.	139 W. 2nd St.
AXtel 1-7000	WOrth 6-5300	FOrdham 7-8813	HUbbard 2-7850	MArket 2-1661	PLainfield 6-4718

LAFAYETTE

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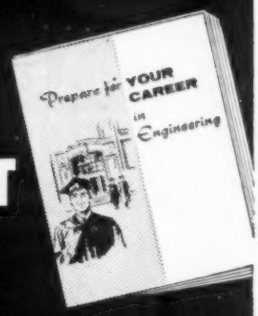

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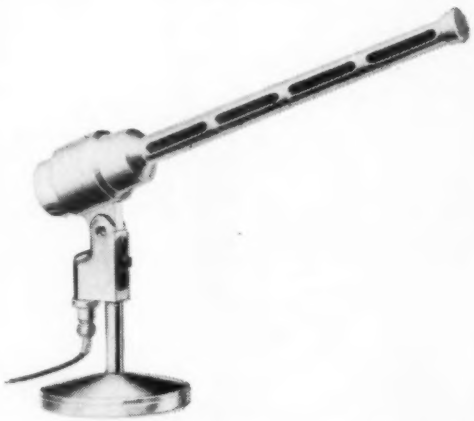
NEW products

DIRECTIONAL MICROPHONE

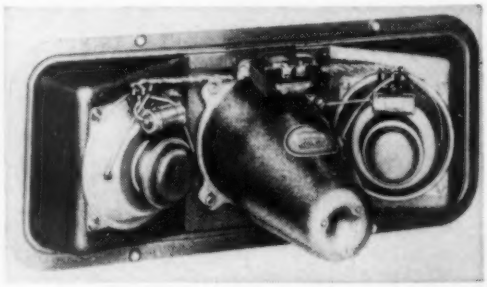
A highly directional microphone which allows up to four times the working distance of present cardiod microphones is being marketed by *Electro-Voice, Inc.*, Buchanan, Mich. The Model 644 "Sound Spot"



microphone features an acceptance angle of 45° each side of the front axis. It has a frequency response of from 40 to 12,000 cps, and provides either 150-ohm or high-impedance outputs. Complete specifications are available from the manufacturer.

MID-RANGE/H.F. SPEAKER

The Isophon Model DHB 6/2-10 mid-range and high-frequency speaker system, being distributed by *Arnhold Ceramics, Inc.*, of



New York City, consists of a mid-range folded horn compression speaker, two tweeters, and a 4- to 6-ohm crossover network. Frequency response is from 1000 to

ALL TUBES INDIVIDUALLY BOXED UNCONDITIONALLY GUARANTEED FOR ONE YEAR

Send for Free Complete Tube List & Order Blank. Your Inquiry Will Put You on Our Mailing List

TELTRON SMASHES PRICES on TUBES for '60!

GIFT OFFER

ONE 6BG6G tube will be shipped **FREE** with any $10.00 or more order accompanying this ad.

FREE

$7.50 list value. Bonus box includes 3 6SN7 tubes & 25 assorted resistors & condensers with each order of $25.00 or more of receiving tubes and special purpose tubes only.

FREE EICO TUBE TESTER

By popular demand we are repeating this fabulous FREE GIVE-AWAY. You get this EICO tube tester kit #625K ABSOLUTELY FREE when you purchase $199.00 worth of receiving tubes from TELTRON within 60 days. Tube tester may be purchased outright for $34.95 PREPAID. Send for FREE list on EICO test eqpmt & Hi-Fi Compnts.

SAVE ON ALL TUBES . . . HERE'S A PARTIAL LIST OF MOST OFTEN USED TUBES

0Z4	.45	6AL5	.43	6DE6	.43	12BE6	.46
1B3GT	.62	6AM8	.59	6DG6GT	.50	12BH7	.61
1R5	.51	6AN8	.64	6DQ6	.89	12BQ6	.63
1S5	.43	6AQ5	.48	6H6	.47	12BY7	.65
1T4	.51	6AS5	.48	6J5	.49	12CR6	.43
1U4	.51	6AU4GT	.52	6J6	.61	12CU6	.63
1U5	.43	6AU5GT	.50	6K6GT	.39	12DB5	.59
1X2	.62	6AU6	.60	6S4	.41	12DQ6	.63
2AF4	1.02	6AV6	.43	6SA7	.45	12K5	.44
2BN4	.55	6AW8	.37	6SC7	.45	12SA7	.45
3AU6	.43	6AX4GT	.50	6SK7	.44	12SK7	.45
3BC5	.56	6BA6	.60	6SL7GT	.45	12SN7GT	.56
3BN6	.90	6BA8	.56	6SN7GT	.60	12SQ7	.45
3BZ6	.45	6BC5	.49	6SQ7	.60	12V6GT	.38
3CB6	.51	6BC8	.48	6T8	.38	12L6GT	.43
3DT6	.51	6BE6	.59	6U8	.71	12W6GT	.43
3V4	.51	6BF5	.46	6V6GT	.76	17DQ6	.68
4BC8	.69	6BG6G	1.18	6W4GT	.48	19AU4	.60
4BQ7	.75	6BH6	.51	6W6GT	.43	19BG6G	1.48
4CB6	.51	6BJ6	.51	6X4	.53	25BQ6GT	.82
5AM8	.59	6BK5	.51	6X8	.37	25CD6G	1.19
5AN8	.64	6BK7	.78	7AU7	.75	25CU6	.82
5AT8	.54	6BL7GT	.78	8CG7	.53	25L6GT	.41
5AV8	.54	6BN4	.46	8CM7	.54	25W4GT	.43
5BK7	.68	6BN6	.44	9U8	.54	25Z6GT	.36
5J6	.61	6BQ6GT	.90	10DE7	.79	35B5	.48
5T8	.59	6BQ7A	.83	12AB5	.49	35C5	.48
5U4G	.43	6BY5G	.85	12AF6	.44	35L6GT	.41
5U4GA	.45	6BZ6	.75	12AT6	.44	35W4	.33
5U4GB	.45	6BZ7	.45	12AT7	.37	35Z5GT	.33
5U8	.59	6C4	.95	12AU6	.41	50B5	.48
5V4G	.49	6CB6	.41	12AU7	.71	50C5	.48
5X8	.55	6CG6G	.51	12AV6	.43	50L6GT	.50
5Y3GT	.30	6CF6	1.63	12AV7	.58	117Z3	.33
6AB4	.43	6CG7	.45	12AX4GT	.42	117Z6GT	.65
6AC7	.65	6CH8	.44	12AX7	.60		
6AF4	1.02	6CM7	.54	12AZ7	.61		
6AG5	.52	6CS6	.44	12BA7	.65		
6AH6	.47	6CU6	.45	12BH7	.52		
			.95	12BA6	.46		

SEND FOR FREE COMPLETE LIST OF MOST OFTEN USED TUBE TYPES.

New and hard to get types. Prompt delivery.

1DN5	.60
1G3GT/1B3	.70
2CY5	.50
3AF4	1.02
4DE6	.55
4DT6	.59
5CQ8	.59
6BJ8	.64
6BQ5	.74
6CQ8	.59
6CX8	.64
6DS5	.69
8AW8	.75
8CX8	.90
11CY7	.74
12EK6	.59
17AX4GT	.50
17D4	.50
50EH5	.59

These and many other "NEW & HARD TO GET" types in stock now. SEND APPROXIMATE COST FOR ANY TYPE. EXCESS WILL BE REFUNDED.

A small portion of obsolete and seldom used tubes. Immediate Shipment!

1A6	.93	7A7	.42
1C5GT	.57	7B4	.44
1C7G	.39	7B5	.41
1F5G	.39	7B8	.47
1H4G	.39	7C5	.44
1LA6	.66	7F8	.47
1LB4	.66	7H7	.51
1LH4	.66	7N7	.52
1LN5	.66	7V7	.82
3LF4	.66	7Y4	.35
5T4	.59	7Z4	.40
6A6	1.00	12A8GT	.45
6A7	.59	12K7GT	.40
6A8	.40	12Q7GT	.48
6AB7/ 1853	.60	12SR7	.57
6AQ7GT	.60	14A7	.43
6AS7G	1.50	14B6	.38
6D6	.59	14Q7	.52
6F5GT	.44	27	.45
6F6	.42	35A5	.48
6S7G	.89	35Y4	.35
6SB7Y	.50	37	.59
6SR7	.43	39/44	.39
6U5	.54	45	.55
6U7G	.40	80AS	.48
7A4/ XXL	.47	80X6	.53
7A6	.47	84	.48
7A8	.46	71A	.65
		75	.44
		77	.55
		80	.40

FREE Postage on all tube Specials

Spec. Ind.	Purpose. Tubes	Trnsmtg & (Immed. Shpmt)		
0A2	.70	807	1.00	
2A4G	.75	811A	3.25	
2D21	.65	813	9.25	
2E26	2.50	833A	40.00	
2X2	.75	866A	1.00	
5R4GY	1.00	2050	.85	
6J4	1.25	5675	12.25	
12A6	.60	5879	1.10	
FG27	8.50	6146	3.85	
HY69	1.75	6161	34.50	
2N63	3.75	2N633	1.35	
2N130A	2.75	CK13	4.00	
		CK22	3.50	
2N329A	40.00	CK709	16.50	
2N484	1.75	CK844	6.50	
2N622	30.00	CK863	9.75	

New Price Schedule of TELEVISION PICTURE TUBES

PICTURE GUARANTEED FOR ONE (1) YEAR

8DP4	*	17AVP4	15.75	21AUP4	19.25
10ABP4	*	17EP4	13.25	21AVP4	19.25
10BP4	7.95	17FP4	17.25	21AWP4	18.75
12LP4	10.75	17GP4	17.95	21EP4	17.25
14BP4	11.75	17HP4	16.49	21FP4	19.25
14CP4	11.95	17JP4	16.49	21MP4	21.25
14QP4	13.25	17LP4	17.45	21WP4	17.25
14RP4	14.25	17QP4	13.25	21XP4	18.75
16AP4	16.45	17TP4	16.49	21YP4	18.75
16CP4	12.49	17YP4	16.49	21ZP4	17.25
16DP4	11.99	19AP4	18.25	24ABP4	*
16EP4	15.99	20CP4	15.75	24AP4	*
16GP4	15.99	20DP5	15.75	24CP4	27.25
16HP4	12.49	20HP4	17.75	24DP4	28.75
16KP4	11.95	21ACP4	21.95	24TP4	*
16LP4	11.95	21ALP4	18.75	24VP4	*
16RP4	11.95	21AMP4	18.75	24YP4	*
16TP4	11.95	21AP4	21.25	24EP4	*
17ATP4	16.75	21ATP4	19.25	27RP4	*

* Price upon request.

Aluminized on any tube, $4.00 extra. All picture tubes require a deposit on your dud. Please add an additional $5.00 on tube sizes to 17". Add $7.00 on sizes 19", 20", 21" and 24"s. Your cash deposit will be refunded immediately upon receipt of your dud prepaid.

Picture tubes are shipped promptly from our warehouse (the US Continent and Canada only) F.O.B. Harrison, New Jersey.

Receiving Tube Specials

6SN7GT A & B	Lots of 50	$24.50
	Lots of 100	$44.50
6W4GT	Lots of 50	$18.95
	Lots of 100	$34.95
12AU7 & A	Lots of 50	$24.95
	Lots of 100	$47.95
6AU6 & A	Lots of 50	$18.95
	Lots of 100	$34.95
6CB6 & A	Lots of 50	$22.95
	Lots of 100	$41.95

Below listed semiconductors are widely used in electronics today. These are but a few of the hundreds of types available to you. Order what you need or write us of your requirements.

1N34	.49	1N256	19.95
1N38	.95	1N295	.30
1N60	.34	1N460A	4.60
1N66	.49	1N1096	9.00
1N82A	1.00		
1N253	4.25		

Heavy Duty Solder Gun Kit. 135w gun, with dual spotlight. Incl. wire soldering brush, make tight wire twists and re-open old solder joints. Lg. pkg. solder. Prepd $4.95; 3 for $14.29

FIBER FUSE CLIPS . . . 15¢ ea. 12 for $1.65 PPD.

RCA CHEATER CORDS . . . 39¢ ea. 6 for $1.95 PPD.

Complete Outdoor All Channel Conical Antenna. Local or fringe. Incl: 8 elmt antenna w cresbr; 5-ft. mast alum; chim. mt or 7-ft. wall brkt (state need) 8 standoffs; 50' 300-ohm wire (List $15.) **$7.99**; lots of 3, **$7.49**; FOB Harrison, N. J. Im. divy.

Switch-Type Indoor Antenna. Shipped Postage Paid. New 6 position switch for use on UHF, VHF and color Sets. Neat Pkg. **$2.99**
Lots of 8 **$2.49**

PARALLEL PICTURE TUBE BRIGHTENER . . . 99c
Series type . . $1.39

AUTO VIBRATORS

6v	4 Pr.	Universal	$1.59
12v	3 Pr.	Standard	1.79
12v	4 Pr.	Standard	1.99

NEW LIBERAL TERMS. No minimum order. Free postage on all tube & parts orders over $5.00 in U.S.A., APOs & Territories. 25% deposit required on CODs. Please send approximate postage on Canadian and foreign shipments. Excess will be refunded.
All picture tubes and outdoor antennas shipped FOB Harrison, New Jersey.

Tubes listed may be factory seconds or used tubes and are clearly marked.

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DEPT. PE-3

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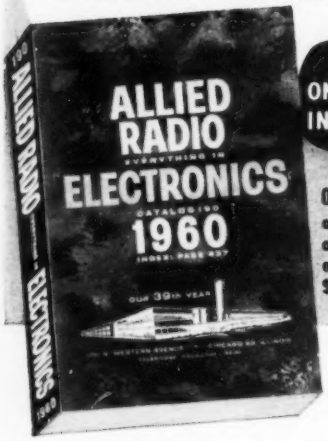

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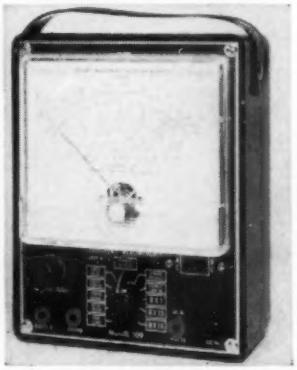
products

(*Continued from page* 30)

17,000 cps, and power rating is 25 watts. Size, $6\frac{11}{16}$" x $7\frac{11}{16}$" x $15\frac{3}{4}$". Price, $43.25.

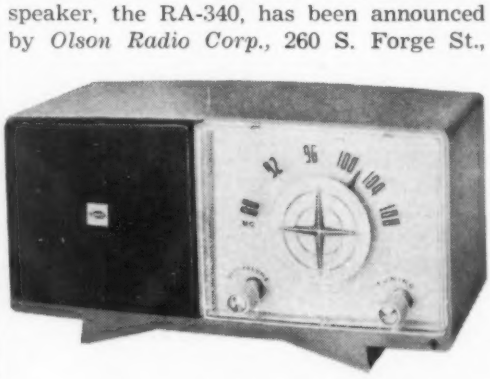
VOLT-OHM-MILLIAMMETER

Available either as a kit or factory-wired, the EMC Model 109 VOM features a 40-microampere 4½" meter and a.c. voltage sensitivity of 10,000 ohms per volt. The d.c. voltage range extends to 3000 volts at a sensitivity of 20,000 ohms per volt; the top a.c. voltage range is also 3000 volts. Three ranges are incorporated for a.c. and d.c. current measurements, and resistance measurements to 20 megohms are covered in three ranges. Prices: wired, $26.95; in kit form, $19.25. (*Electronic Measurements Corp.*, 625 Broadway, New York, N. Y.)



FM RADIO

A table-model FM radio with a built-in speaker, the RA-340, has been announced by *Olson Radio Corp.*, 260 S. Forge St., Akron, Ohio. This six-tube receiver has a closed-circuit jack for connection to an external speaker. Price, $22.77.

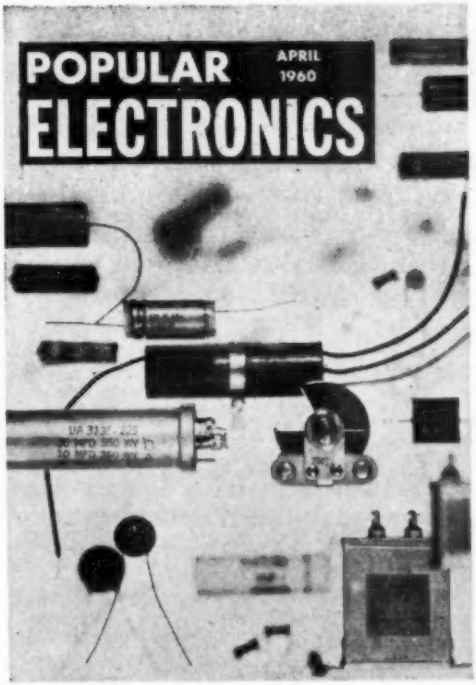


STEREO BALANCE METER

The Park "Stereo-Monitor" is a device for balancing the volume of each channel of a stereo system; when equal power is being fed to both speakers, its needle indi-

COMING IN APRIL...

SPECIAL 16-PAGE BONUS FEATURE ON THE CAPACITOR:



What it is

What it does

How it works

How does a capacitor store an electrical charge? How does it block d.c. current, yet pass a.c.? How do the various types of capacitors differ in constructon and in practical application?

All these and many other questions will be answered for you in this giant bonus section featured in April POPULAR ELECTRONICS—detailing the uses of the capacitor from A to Z!

You'll also enjoy reading these other informative April POPULAR ELECTRONICS features about some of the latest developments in electronics:

- **THE MASER—JEWEL THAT CONQUERS SPACE:** Complete rundown on the tiny synthetic ruby that increases the sensitivity of radar up to 100 times by harnessing the internal energy of the electron!
- **THERMOPLASTIC RECORDING**—The story of a revolutionary new recording process which combines the major features of magnetic and photographic recording!
- **BUILD:**
  - An Electronic Fence Charger: Keep pests out or animals in! Low priced, easy to build!
  - Multi-Purpose Wattmeter: Complete plans and diagrams for building this meter which checks the wattage consumed by your electrical appliances!
- **PLUS MUCH, MUCH MORE!**

These exciting April POPULAR ELECTRONICS features are typical of the coverage you'll enjoy month after month in the world's leading electronic hobbyist magazine. Take advantage of the present low subscription rates to bring POPULAR ELECTRONICS to your door every month—subscribe today!

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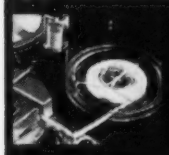
... BECAUSE THEY ADD LONGER LIFE TO HI-FI EQUIPMENT

*From GERONTOLOGY—study of old age

HEAD-DEMAG TAPE HEAD DEMAGNETIZER

Safely removes all trace of magnetism from recording heads. Reaches most heads with cover left on; on-off switch eliminates unplugging when device is not in use. Curved, flat tip is plastic-covered; can't scratch or damage.

Cat No. 30-112 **List: $9.95**



KLEENTAPE

Tape head cleaner safely removes dirt, grease, and distortion-causing oxide deposits. Consists of 100' of specially impregnated cloth tape on 5" reel. "Plays" through any standard tape recorder in less than 2 minutes.

Cat No. 30-126 **List: $2.95**

DUST BUG

Miracle record cleaner and static eliminator works 4-ways to end dust-damage. Automatically applies cleaning fluid, brushes dirt from grooves, sweeps-up loosened dirt, eliminates static charge while record is playing.

Cat No. 30-014 (changer model) **List: $7.90**

Cat No. 30-012 (player model) **List: $9.60**

PHONO GUARD DUST COVER

Dust protection with flair! Smartly styled plastic phono and turntable covers with collapsible metal frame that folds flat for storage; keeps cover rigid when in use. Fits most turntables and many changers. 5" x 15½" x 12¼".

Cat No. 30-056 **List: $6.95**

STYLUS MICROSCOPE

Worn needles destroy records! This optical instrument is a practical tool for periodically checking stylus condition ... before record damage occurs. Has adjustable focus and 50x magnification. Complete with pen-type pocket clip.

Cat No. 30-218 **List: $2.50**

audiotex STEREO/AUDIO ACCESSORIES

AUDIOTEX MFG. CO., Div. of GC-TEXTRON INC.
- 3225 Exposition Pl. Los Angeles 18, Cal
- 400 S. Wyman St., Rockford, Ill.
- IN Canada: ATLAS RADIO CORP., Ltd. Toronto 19

SEND ME **FREE** CATALOG OF 170 ACCESSORIES

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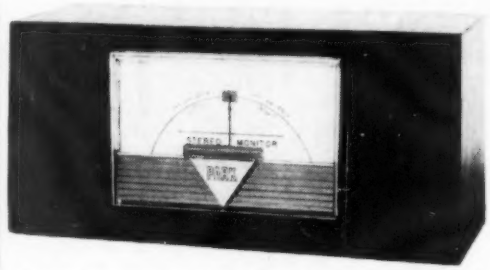
City _____ Zone ____ State _____

products

(*Continued from page* 32)

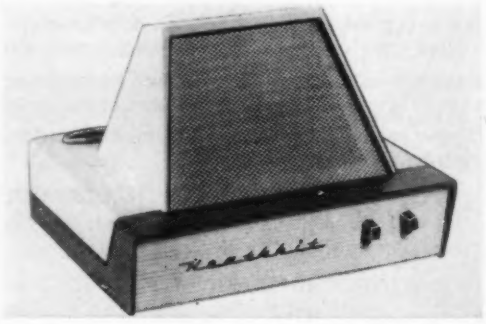
cator points straight up. This monitor unit can be connected into a stereo system quickly and is capable of handling up to



30 watts on each channel. Price, $14.95. (*Vokar Products, Inc.*, 201 E. Catherine St., Ann Arbor, Mich.)

TRANSISTOR INTERCOM KIT

A transistorized intercom system in kit form has recently been announced by the *Heath Company*, Benton Harbor, Mich. Powered by a set of eight "C" cells, the master unit draws current only when it is in use; batteries should provide up to 300 hours of operation. The master unit can call any remote station singly or in any



combination, and any remote station can initiate a call to the master. The master unit will accommodate up to five remote stations. Price: Model XI-1 Master Unit, $27.95; Model XIR-1 Remote Station, $6.95.

SEMI-KIT SPEAKERS

Three new speaker system kits, each with a factory-assembled cabinet, are available from *Electronic Instrument Co., Inc.* (*EICO*), 33-00 Northern Blvd., Long Island City, N. Y. Models HFS-3 and HFS-4 both incorporate a 12" bellows-suspension woofer which has a free-air resonance of 22 cps;

(*Continued on page* 38)

IMPORTANT: For the man who wants to make big money in Radio-Television!

ONLY SPRAYBERRY TRAINING IN RADIO and TELEVISION

offers you all of these vital new advantages to help you earn more money from the start!

NEW Transistor Course
... literally millions of new transistor radios are being used. We show you how to make money fixing them!

NEW Business Builders
... through these practical proven plans and ideas we help you make plenty of extra money in spare time while training!

NEW Training Equipment
... the famous Sprayberry Training kits have been newly engineered by our staff to offer you the latest in Radio-TV Service Techniques!

NEW High Fidelity
... there's big money to be made installing and servicing Hi-Fi units. Your Sprayberry training now offers you this valuable and profitable preparation!

TRAIN AT HOME—SPARE TIME WITH THESE 25 BIG COMPLETE KITS of PARTS & EQUIPMENT

You learn Radio-TV Servicing the best way... the practical way ... building and assembling these modern kits of equipment.

The new Sprayberry Training Television Receiver, built and tested in 5 sections.

Now offered ... this fine modern oscilloscope.

You build this powerful two-band superheterodyne radio receiver.

You build the new Sprayberry tester — a complete 18-range Volt-Ohm-Milliammeter test meter.

FREE These two big new books are yours free! Find out what Radio-Television offers you ... and let us show you how easily you can learn, even without previous experience of any kind. Rush COUPON today!

SPRAYBERRY ACADEMY OF RADIO-TELEVISION
Dept. 105-H, 1512 West Jarvis Ave., Chicago 26, Ill.

The field of Radio-Television Servicing is such a fast moving industry that the best jobs and biggest incomes always go first to the man with the most modern, complete and up-to-date training. Thanks to constant revision and improvement ... Sprayberry Training helps you earn more from the start ... and keeps you earning more in the months and years ahead!

Make no mistake! All radio-television training is *not* alike. The basic purpose behind Sprayberry Training is to prepare you as rapidly and as surely as possible ... to make top money servicing Radio and Television sets and equipment. This is where the big money has been for years ... and will continue to be in the years ahead.

It's important for you to know that for over 30 years ... Sprayberry Training has been preparing ambitious men for success in this interesting and profitable kind of work. Our school has helped hundreds to qualify for the best jobs ... or to get started in profitable businesses of their own. Today our student rolls are the largest in our school's history ... because the need and demand for Radio-Television Service Technicians has never been more urgent.

Just $6.00 Starts You

To encourage more men to enter Radio-Television at once ... to help fill the great need for trained men ... we're making it easier than ever before to start training. Just $6.00 enrolls you. This liberal offer is naturally limited. Get the facts now and consider enrollment while these favorable terms are available to you.

KEEP YOUR JOB ... *while learning*

Under the Sprayberry Plan you train entirely at home in spare time. You combine the most modern lesson training with fascinating and invaluable practical work with 25 big kits of parts and equipment that we supply. You get the equivalent of years of shop practice ... and you can train as fast or as slowly as you wish. We help you make excellent spare time money while learning ... and everything you receive—lessons, books, manuals, equipment—all yours to keep!

This is the Radio-Television industry's most modern and up-to-the-minute training. Sprayberry is the *one* school that gives you personalized attention and takes a real interest in your progress. Remember ... just $6 starts you! Mail the coupon today. Let the facts speak for themselves. Let us send you our new catalog and sample lesson ... and *prove* the kind of opportunity that Sprayberry training can open up for you.

MAIL COUPON – No Salesman Will Call

SPRAYBERRY ACADEMY OF RADIO-TELEVISION
DEPT. 105-H, 1512 W. JARVIS AVE., CHICAGO 26, ILL.

Please rush all information on your ALL-NEW Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me. Include New Catalog and Sample Lesson FREE.

NAME..... AGE.....

ADDRESS.....

CITY..... ZONE.... STATE.....

NOW YOU CAN HAVE YOUR CHOICE OF CENTURY'S UNIQUE Peak-to-Peak VACUUM TUBE VOLT METERS

Model VT-10
LINE OPERATED

WITH LARGE EASY-TO-READ 6" METER
featuring the sensational new
MULTI-PROBE *(Patent Pending)*

Model VT-1
BATTERY OPERATED

No extra probes to buy! The versatile MULTI-PROBE does the work of 4 probes

1 DC Probe 2 AC-Ohms Probe
3 Lo-Cap Probe 4 RF Probe

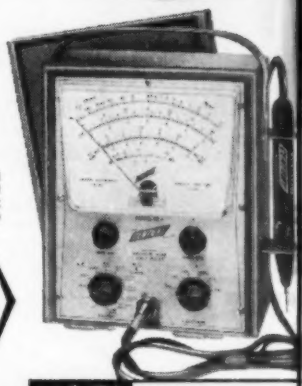
No longer do you have to cart around a maze of entangled cables, lose time alternating cables or hunting for a misplaced probe. With just a twist of the MULTI-PROBE tip you can set it to function as either a DC Probe, AC-Ohms Probe, Lo-Cap Probe or RF Probe.

Model VT-10 **$58.50** Net

TERMS: $14.50 within 10 days. Balance $11 monthly for 4 months.

LINE OPERATED
Ideal for use on the test bench. Designed to run cool even under continuous operation . . . Line isolated.

BATTERY OPERATED
Completely portable . . . Invaluable wherever line connection is undesirable or unavailable . . . Unique circuitry assures low battery drain.



Model VT-1 **$58.50** Net

TERMS: $14.50 within 10 days. Balance $11 monthly for 4 months.

FUNCTIONS OF VT-1 and VT-10

DC VOLTMETER . . . Will measure D.C. down to 1.5 volts full scale with minimum circuit loading, and give accurate readings at scale divisions as low as .025 volts . . . Will measure low AGC and oscillator bias voltages from .1 volts or less up to 1500 volts with consistent laboratory accuracy on all ranges . . . Zero center provided for all balancing measurements such as discriminator, ratio detector alignment and hi-fi amplifier balancing.

AC VOLTMETER . . . True Peak-to-Peak measurements as low as 3 volts of any wave form including TV sync, deflection voltages, video pulses, distortion in hi-fi amplifiers, AGC and color TV gating pulses . . . Scale divisions are easily read down to .1 volts . . . Measures RMS at 1/20th the circuit loading of a V.O.M. . . . Unlike most other V.T.V.M.'s there is no loss in accuracy on the lowest AC range.

ELECTRONIC OHMETER . . . Measures from 0 to 1000 megohms . . . Scale divisions are easily read down to .2 ohms . . . Will measure resistance values from .2 ohms to one billion ohms . . . Will detect high resistance leakage in electrolytic and by-pass condensers.

RF and LO-CAP MEASUREMENTS . . . With these extra VT-1 functions you can measure voltages in extremely high-impedance circuits such as sync and AGC pulses, driving saw tooth voltages, color TV gating pulses, mixer output levels, I.F. stage-by-stage gain and detector inputs.

FEATURES OF VT-1 and VT-10

- New advanced pentode amplifier circuit
- Large 6" 100-microampere meter, many times more sensitive than meters used in most V.T.V.M.s
- Simplified multi-color easy-to-read 4-scale meter
- No heat operation assures stability and accuracy
- Amplifier rectifier circuit with frequency compensated attenuator — a feature found only in costly laboratory instruments
- Meter completely isolated
- Hand-crafted circuitry eliminates the headaches of printed circuitry
- 1% resistors used for permanent accuracy
- Rugged gray hammertone steel case provides necessary shielding and eliminates plastic case drawbacks of cracking or melting
- Deep brushed long lasting etched aluminum panel
- Matching cover protects instrument face — snaps on and off instantly.

SPECIFICATIONS OF VT-1 and VT-

- **DC Volts** — 0 to 1.5/6/30/150/300/60 1500 volts
- **AC Volts (RMS and Peak-to-Peak)** — 3/12/60/300/1200 volts
- **Ohms** — to a billion ohms, 10 ohms ce ter scale — RX1/10/100/1K/10K/100K 1M
- **RF** — Peak reading demodulator su plied for use on all DC ranges
- **Zero Center** — available on all DC v ranges with zero at mid-scale
- **Decibles** — from —10 Db to +10/2 36/50/62 based on the Dbm unit: 00 1MW in 600 ohms
- **Impedance** — 11 megohms DC, 1 m ohm AC, 10 megohms Lo-Cap
- **Input Capacity** — 130 mmfd. RMS, 2 mmfd. Peak-to-Peak, 25 mmfd. Lo-Cap

Model CT-1 IN-CIRCUIT CONDENSER TESTER

Here is an IN-CIRCUIT CONDENSER that DOES THE WHOLE JOB! The CT-1 actually steps in and takes over where all other in-circuit condensers fail. The ingenious application of a dual bridge principle gives the CT-1 a tremendous range of operation . . . and makes it an absolute 'must' for every serviceman.

in-circuit checks:

- Quality of condensers even with circuit shunt resistance . . . (This includes leakage, shorts, opens, intermittents)
- Value of all condensers from 200 mmfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- Transformer, socket and wiring leakage capacity

out-of-circuit checks:

- Quality of condensers . . . (This includes leakage, shorts, opens and intermittents)
- Value of all condensers from 50 mmfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- High resistance leakage up to 300 megohms
- New or unknown condensers . . . transformer, socket, component and wiring leakage capacity

OUTSTANDING FEATURES

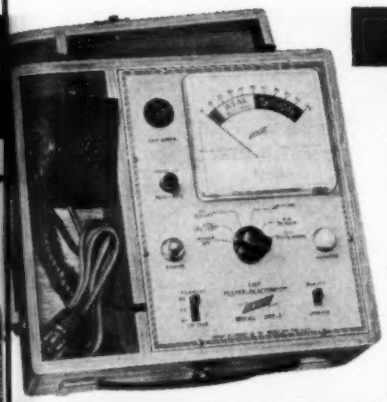
- Ultra-sensitive 2 tube drift-free circuitry
- Multi-color direct scale readings for both quality and value . . . in-circuit or out-of-circuit
- Simultaneous readings of circuit capacity and circuit resistance
- Built-in hi-leakage indicator sensitive to over 300 megohms
- Cannot damage circuit components
- Electronic eye balance indicator for even greater accuracy
- Isolated power line
- Deep brushed long lasting etched aluminum panel
- Housed in sturdy gray hammertone finish steel case . . . comes complete with test leads

Model CT-1 **$34.50** Net

TERMS: $9.50 within 10 days. Balance $5 monthly for 5 months.

10 DAY *FREE* TRIAL ON CENTURY INSTRUMENTS OF YOUR CHOICE

See for yourself at no risk why thousands of servicemen all over the country selected CENTURY test equipment above all others. Send for instruments of your choice without obligation . . . try them for 10 days before you buy . . . only then, if satisfied, pay in easy-to-buy monthly installments — without any financing or carrying charges added.



Model CRT-2

CRT TESTER-REACTIVATOR

TESTS, REPAIRS and REACTIVATES

- ***ALL BLACK AND WHITE PICTURE TUBES*** *(including 110° tubes)* . . . from 8" to 30", whether 12 pin base, 9 pin base, 14 pin base . . . and the very latest 7 pin base.
- ***ALL COLOR PICTURE TUBES*** . . . Each of the red, green and blue color guns is handled separately.

CHECK THESE EXCLUSIVE FEATURES

- **THE MULTI-HEAD** (Patent Pending) . . . **A SINGLE PLUG IN CABLE AND UNIQUE TEST HEAD** —A tremendous advance over the maze of cables and adapters generally found with other testers.
- **WATCH IT REACTIVATE THE PICTURE TUBE** — You actually see and control the reactivation directly on the meter as it takes place. This allows you for the first time to properly control the reactivation voltage and eliminates the danger of stripping the cathode of the oxide coating. It also enables you to see whether the build-up is lasting.
- **CONTROLLED "SHOT" WITH HIGHER VOLTAGE FOR BETTER REACTIVATION** — Stronger than any found in other testers — high enough to really do the job — yet controlled to avoid damage to the picture tube.
- **UNIQUE HIGH VOLTAGE PULSE CIRCUIT** — Will burn out inter-element shorts and weld open circuits with complete safety to the picture tube.
- **VISUAL LIFE TEST** — Enables both you and your customer to see the life-expectancy of any picture tube right on the meter . . . helps eliminate resistance to picture tube replacement when necessary.
- **SPECIAL LOW SCREEN VOLTAGE TUBES** — Will handle new type picture tubes with special low voltage of approximately 50 volts.
- **SEPARATE FILAMENT VOLTAGES** — including the very latest 2.35 volt and 8.4 volt types as well as the older 6.3 volt types.
- **NEW 'SF' PICTURE TUBES** — Accommodates the different base pin connections of this new type picture tube.

Model CRT-2 **$57.50** Net

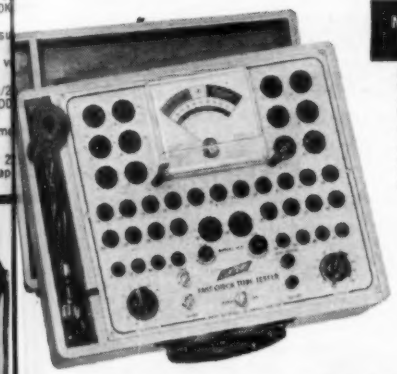
TERMS: $13.50 within 10 days. Balance $11 monthly for 4 months.

CRT-2 DOES ALL THIS RIGHT IN THE CARTON, OUT OF THE CARTON OR IN THE SET

TEST
- For quality of every black and white and color picture tube, employing the time proven dynamic cathode emission test principle.
- For inter-element shorts and leakage up to one megohm. Separate short test provided for each element in the picture tube.
- For life expectancy.

REPAIR
- Will clear inter-element shorts and leakage.
- Will weld open elements.

REACTIVATE
- The "SHOT" (high voltage controlled pulse) method of reactivation provided by the CRT-2 will restore picture tube to new life in instances where it was not possible before. The high voltage is applied without danger of stripping the cathode as you always have perfect control of the high voltage pulse.
- The "BOOST" method of reactivation also provided by the CRT-2 is used effectively on tubes with a superficially good picture but with poor emission and short life expectancy. It will also improve definition, contrast and focus greatly and add longer life to the picture tube.



Model FC-2

FAST-CHECK TUBE TESTER

Simply set two controls . . . insert tube . . . and press quality button to test any of over 900 tube types completely, accurately . . . IN JUST SECONDS!

The FAST-CHECK enables you to cut servicing time way down, eliminate unprofitable call-backs and increase your dollar earnings by selling more tubes with very little effort on your part. You make every call pay extra dividends by merely showing your customer the actual condition and life expectancy of the tube. The extra tubes you will sell each day will pay for the FAST-CHECK in a very short time.

PICTURE TUBE TEST ADAPTER INCLUDED WITH FAST-CHECK
Enables you to check all picture tubes (including the new short-neck 110 degree type) for cathode emission, shorts and life expectancy . . . also to rejuvenate weak picture tubes.

RANGE OF OPERATION

- Checks quality of over 900 tube types, employing the time proven dynamic cathode emission test. This covers more than 99% of all tubes in use today, including the newest series-string TV tubes, auto 12 plate-volt tubes, 0Z4s, magic eye tubes, gas regulators, special purpose hi-fi tubes and even foreign tubes.
- Checks for inter-element shorts and leakage.
- Checks for gas content.
- Checks for life-expectancy.

SPECIFICATIONS

● No time consuming multiple switching . . . only two settings are required instead of banks of switches on conventional testers ● No annoying roll chart checking . . . tube chart listing over 900 tube types is located inside cover. New listings are added without costly roll chart replacement ● Checks each section of multi-section tubes and if only one section is defective the tube will read "Bad" on the meter scale ● 41 phosphor bronze beryllium tube sockets never need replacement ● 7-pin and 9-pin straighteners mounted on panel ● Large 4½" D'Arsonval type meter is the most sensitive available, yet rugged — fully protected against accidental burn-out ● Special scale on meter for low current tubes ● Compensation for line voltage variation ● 12 filament positions ● Separate gas and short jewel indicators ● Line isolated — no shock hazards ● Deep brushed long lasting etched aluminum panel.

Housed in hand-rubbed oak carrying case complete with CRT ADAPTER

Model FC-2 **$69.50** Net

TERMS: $14.50 within 10 days. Balance $11 monthly for 5 months.

NOTE: **The Fast-Check positively cannot become obsolete . . . circuitry is engineered to accommodate all future tube types as they come out. New tube listings are furnished periodically at no cost.**

CENTURY ELECTRONICS CO., INC. 111 Roosevelt Ave., Dept. 303 Mineola, N. Y.

- ☐ Model VT-10 Vacuum Tube Volt Meter ..... $58.50 — $14.50 within 10 days. Balance $11 monthly for 4 months.
- ☐ Model VT-1 Battery Vacuum Tube Volt Meter ..... $58.50 — $14.50 within 10 days. Balance $11 monthly for 4 months.
- ☐ Model CT-1 In-Circuit Condenser Tester ..... $34.50 — $9.50 within 10 days. Balance $5 monthly for 5 months.
- ☐ Model CRT-2 CRT Tester-Reactivator ..... $57.50 — $13.50 within 10 days. Balance $11 monthly for 4 months.
- ☐ Model FC-2 Fast-Check Tube Tester ..... $69.50 — $14.50 within 10 days. Balance $11 monthly for 5 months.

Prices Net F.O.B. Mineola, N. Y.

Yes, I want to take advantage of your 10 day FREE try-before-you-buy offer. Ship on approval the instruments I have checked. After I have tried the equipment for 10 full days I will either send you the down payment and agree to pay the balance in the monthly payments shown, or I will return the units and owe nothing.

Name .....
Please print clearly

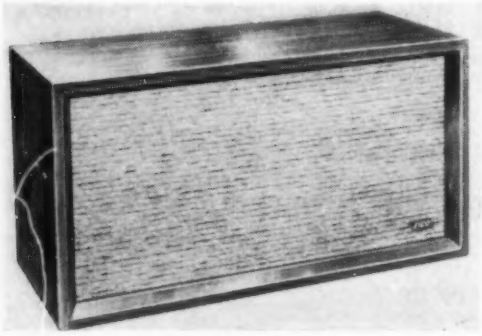
Address .....

City ..... State .....

products

(*Continued from page* 34)

the HFS-3 employs a 3½" cone tweeter and the HFS-4 uses a compression-driver horn tweeter for more brilliant highs. An 8" mid-range speaker covers the middle frequencies in each of these systems, and frequency response is within ±5 db from 45 to 14,000 cps. The Model HFS-5 is a two-way system employing an 8" bellows-suspension woofer and a 3½" cone tweeter, and has a frequency response within ±5 db from 52 to 14,000 cps. Prices: HFS-3 in unfinished birch, $72.50 (in walnut, mahogany, or teak, $87.50); HFS-4 in unfinished birch, $83.50 (in walnut, mahogany, or teak, $98.50); HFS-5 in unfinished birch, $47.50 (in walnut, mahogany, or teak, $59.50).



STEREO PREAMPLIFIER

Accommodating up to 7 stereo sources or 14 monophonic sources, the Dynakit PAS-2 stereo preamplifier features a blend control to eliminate "hole-in-the-middle" effects. Other advantages include printed-circuit construction, a multi-purpose low-level input, and a built-in power supply. Price: in kit form, $59.95; factory-wired, $99.95. (*Dynaco, Inc.,* 3916 Powelton Ave., Philadelphia 4, Pa.) -30-

Build the Best Portable... EICO

6-TRANSISTOR RADIO RA-6

Kit $29.95 Wired $49.95 INCLUDES P. E. P., LESS 9V BATTERY

Easy creative fun to build . . . a lifetime of big-set entertainment wherever you go . . . designed so that even the novice can build it & obtain a handsome professional assembly & outstanding performance. American-made modern super-heterodyne all-transistor circuitry, plus finest quality parts throughout, assure you of highest durability & stability.

• high sensitivity & selectivity • big-set volume & tone quality with 4" x 6" PM speaker & 250 mw push-pull audio output stage • built-in Ferrite rod antenna for good reception in any location • pre-aligned RF & IF transformers • planetary vernier tuning (7:1 reduction) for easy station selection & tuning • high-impedance earphone jack for private listening; eliminates drain of output stage when using earphone • attractive tan leatherette case, retractable handle • compact: 8½" w, 4½" h, 2½" d. Only 3 lbs.

Build the BEST BUYS in "HAM" gear... EICO

*U. S. Pat. No. D-184,776

90-WATT CW TRANSMITTER *#720

Kit $79.95 Wired $119.95

"Ideal for veteran or novice" — ELECTRONIC KITS GUIDE. "Top quality" — POPULAR ELECTRONICS. "Well designed" — ELECTRONICS WORLD. 80 thru 10 meters with one-knob band-switching. Full "clean" 90W input, 65W external plate mod. Matches loads 50 to 1000 ohms. May be used as basic exciter unit. TVI shielded. Tubes: 6146, 6CL6, 2-6AQ5, GZ34. Attractive "living room" low-silhouette design. 15" w, 5" h, 9" d.

UNIVERSAL MODULATOR-DRIVER #730

Kit $49.95 Wired $79.95

Cover E-5 $4.50

Delivers 50W undistorted audio. Modulates transmitters having c.f inputs up to 100W. Unique over-modulation indicator. Output transformer matches 500-10,000 ohms. Low-level speech clipping & filtering. Inputs for xtal or dynamic mikes, phone patch, etc. 7 tubes. 6" h, 14" w, 8" d.

GRID DIP METER #710

Kit $29.95 Wired $49.95

Includes complete set of coils for full band coverage, 400 kc–230 mc in 8 overlapping ranges. 500 ua meter. Plug-in coils are pre-wound, pre-calibrated to 0.5% accuracy. Transformer-operated power supply 2¼" h, 2⅝" w, 6⅞" l.

Compare — judge for yourself — at your neighborhood EICO distributor. For free catalog on 65 models of EICO test instruments, hi-fi & "ham" gear, fill out coupon on Page 40. Add 5% in the West.

ELECTRONIC INSTRUMENT CO., Inc., 33-00 N. Blvd., L. I. C. 1, N. Y.

STOP BUYING TUBES IN THE DARK

BRAND NEW TUBES

Each Tube Individually and Attractively Boxed! You Can Rely On Rad-Tel's Speedy One Day Service!

All Rad-Tel's First Quality! Guaranteed One Full Year!

NOT USED NOT PULLED OUT OF OLD SETS

better than **70%** off

Send For Free Trouble Shooter Guide And New Tube & Parts Catalog.

Not Affiliated With Any Other Mail Order Tube Company.

Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price
	0Z4M	.79		4BZ6	.58		6BC5	.54		6J6	.67		12AX7	.83		12SQ7M	.73
	1AX2	.62		4BZ7	.96		6BC7	.94		6K6	.58		12AZ7	.86		12U7	.62
	1B3GT	.79		4CB6	.59		6BC8	.97		6S4	.48		12B4	.83		12V6GT	.53
	1DN5	.55		4CS6	.81		6BD6	.51		6SA7GT	.76		12BA6	.50		12W6	.69
	1G3	.73		4DE6	.62		6BE6	.55		6SK7GT	.74		12BD6	.50		12X4	.38
	1J3	.73		4DK6	.80		6BF6	.44		6SL7	.80		12BE6	.53		17AX4	.67
	1K3	.73		4DT6	.55		6BG6	1.66		6SN7	.65		12BF6	.44		17BQ6	1.08
	1L6	1.05		5AM8	.79		6BH6	.65		6SQ7	.73		12BH7	.73		17C5	.58
	1LA6	.89		5AN8	.86		6BH8	.87		6T4	.98		12BK5	.70		17CA5	.62
	1LC6	.79		5AQ5	.52		6BJ6	.82		6T8	.80		12BL6	.56		17D4	.69
	1LN5	.58		5AT8	.80		6BK5	.80		6U8	.78		12BQ6	1.06		17DQ6	1.06
	1R5	.62		5BK7A	.82		6BK7	.85		6V6GT	.54		12BY7	.74		17L6	.58
	1S5	.51		5BQ7	.97		6BL7	1.00		6W4	.57		12BZ7	.75		17W6	.70
	1T4	.58		5BR8	.79		6BN4	.57		6W6	.69		12C5	.56		19AU4	.83
	1U4	.57		5CG8	.76		6BN6	.74		6X4	.39		12CA5	.59		19BG6	1.39
	1U5	.50		5CL8	.76		6BQ5	.85		6X5GT	.53		12CN5	.56		19T8	.80
	1X2B	.82		5EA8	.80		6BQ6GT	1.05		6X8	.77		12CR6	.54		21EX6	1.49
	2AF4	.96		5EU8	.80		6BQ7	.95		7AU7	.61		12CU5	.58		25AU4	.87
	2BN4	.60		5J6	.68		6BR8	.78		7A8	.68		12CU6	1.06		25BQ6	1.11
	2CY5	.71		5T8	.81		6BS8	.90		7B6	.69		12CX6	.54		25C5	.53
	3AL5	.42		5U4	.60		6BU8	.70		7Y4	.69		12DB5	.69		25CA5	.59
	3AU6	.51		5U8	.81		6BY6	.54		8AU8	.83		12DE8	.75		25CD6	1.44
	3AV6	.41		5V6	.56		6BZ6	.54		8AW8	.93		12DL8	.85		25CU6	1.11
	3BA6	.51		5X8	.78		6BZ7	.97		8BQ5	.80		12DM7	.67		25DN6	1.42
	3BC5	.54		5Y3	.48		6C4	.43		8CG7	.82		12DQ6	1.04		25EN5	.55
	3BE6	.52		6AB4	.48		6CB6	.54		8CM7	.68		12DS7	.79		25L6	.57
	3BN4	.83		6AC7	.98		6CD6	1.42		8CN7	.97		12DZ8	.56		25W4	.68
	3BN6	.76		6AF3	.73		6CF6	.64		8CX8	.93		12EL6	.50		25Z6	.66
	3BU8	.78		6AF4	.97		6CG7	.60		8EB8	.94		12EQ6	.54		35C5	.51
	3BY6	.55		6AG5	.85		6CG8	.77		10DA7	.71		12EK6	.56		35L6	.57
	3RZ6	.55		6AH6	.99		6CM7	.66		11CY7	.75		12EZ6	.53		35W4	.52
	3CB6	.54		6AK5	.95		6CN7	.65		12A4	.60		12F5	.66		35Z5GT	.60
	3CF6	.60		6AL5	.47		6CR6	.51		12AB5	.55		12F8	.68		50B5	.60
	3CS6	.52		6AM8	.78		6CS6	.57		12AC6	.49		12FM6	.45		50C5	.53
	3CY5	.71		6AN4	.95		6CU5	.58		12AD6	.57		12K5	.65		50DC4	.37
	3DE6	.62		6AN8	.85		6CU8	1.08		12AE6	.43		12SA7M	.86		50EN5	.55
	3DK6	.60		6AQ5	.50		6CY5	.70		12AF3	.73		12SK7GT	.74		50L6	.61
	3DT6	.50		6AR5	.55		6CY7	.71		12AF8	.49		12SN7	.67		117Z3	.81
	3Q5	.80		6AS5	.60		6DA4	.68		12AJ8	.46						
	3S4	.61		6AT6	.43		6DB5	.89		12AL5	.45						
	3V4	.58		6AT8	.78		6DE6	.58		12AL8	.95						
	4AU6	.54		6AU4	.82		6DG6	.59		12AQ5	.52						
	4BA6	.51		6AU6	.50		6DQ6	1.10		12AT6	.43						
	4BC5	.56		6AU7	.61		6DT5	.76		12AT7	.76						
	4BC8	.96		6AU8	.87		6DT6	.53		12AU6	.50						
	4BE6	.54		6AV6	.40		6EU8	.79		12AU7	.80						
	4BN6	.75		6AW8	.89		6EA8	.79		12AV5	.97						
	4BQ7	.96		6AX4	.65		6EB8	.94		12AV6	.41						
	4BS8	.98		6AX7	.64		6H6GT	.58		12AV7	.75						
	4BU8	.71		6BA6	.49		6J5GT	.51		12AX4	.67						

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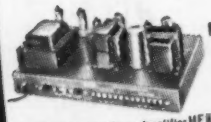

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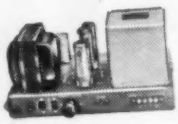

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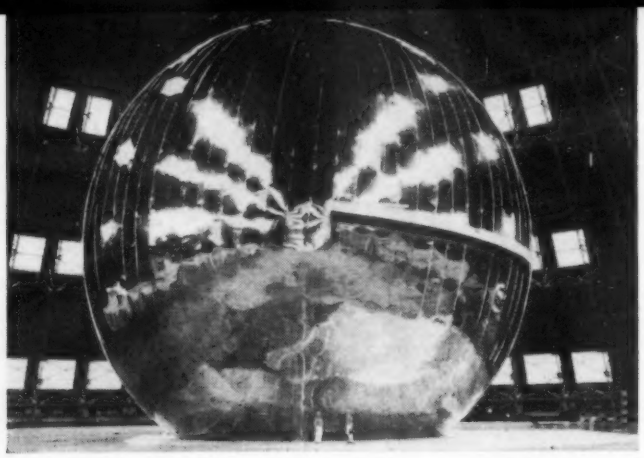
Communications Satellites

-Key to World-Wide TV

By KEN GILMORE

Sooner than you think—probably within ten years—satellites will make it possible for you to watch live TV programs from foreign countries

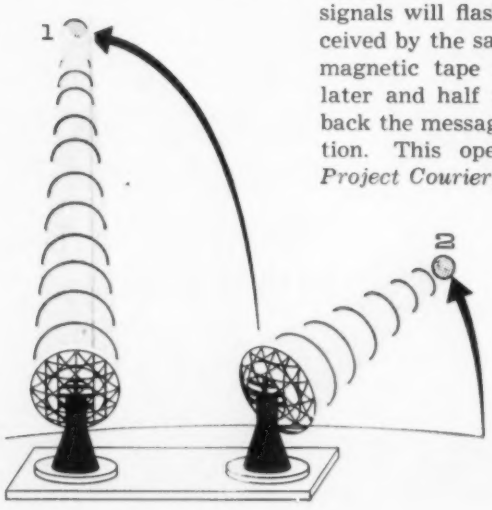


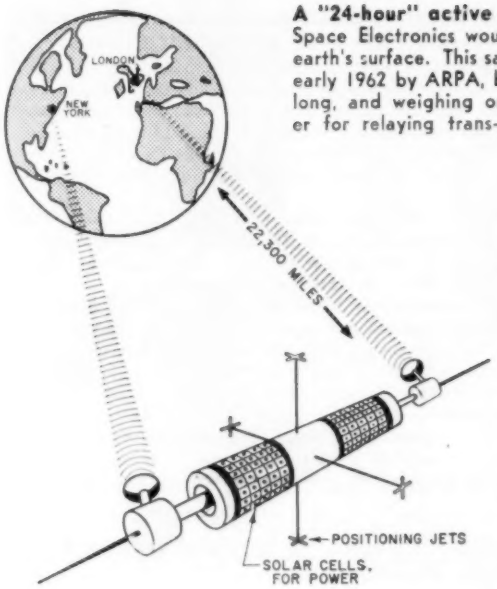
Balloon satellites to be used in *Project Echo* are made of tough plastic film coated with a thin layer of aluminum. Entire satellite, including the firing container, weighs only 190 pounds. Balloon is inflated when sun's rays cause water inside it to turn into steam.

EARLY this spring, a powerful rocket will roar into space and eject a strange payload: a rumpled bundle of plastic that will within minutes puff itself into a shining sphere one hundred feet in diameter. As this weird space balloon soars through its orbit 1000 miles above the earth, thousands of radio signals will shoot skyward from ground stations, ricochet from the satellite's polished surface, and dive back to earth to be received thousands of miles from where they started. The experiment, run by the U. S. National Aeronautics and Space Administration (NASA), will be known as *Project Echo*.

A short time later—probably before summer—the U. S. Advanced Research Projects Agency (ARPA), which directs our military space program, will hurl a different kind of "talking satellite" into orbit. It will be much smaller than NASA's hundred-foot sphere, and packed with complex electronic equipment. As it glides over one continent, signals will flash from the earth to be received by the satellite and recorded on tiny magnetic tape recorders. A few minutes later and half a world away, it will play back the message to a ground listening station. This operation will be known as *Project Courier*.

Operation of a "passive" satellite relay system—such as *Project Echo*—is diagrammed below. While signals are being bounced off satellite *1*, the second antenna begins to track satellite *2*, preparatory to switching from *1* to *2*. Scientists calculate that 25 such "sky-mirrors" in orbit would give world-wide coverage.





A "24-hour" active satellite repeater like the one at left designed by Space Electronics would appear to hang suspended over one spot on the earth's surface. This satellite is basically similar to the one to be launched in early 1962 by ARPA, but it is much smaller, measuring only six to eight feet long, and weighing only 500 pounds. Solar cells would provide the power for relaying trans-Atlantic television, telephone, and teletype signals.

While *Echo* and *Courier* are the most comprehensive space communications projects planned to date, they are not alone. At least one talking moon is already in orbit; scores of others will soon be filling the air with electronic signals. Almost overnight, sooner than anyone believes possible, the age of satellite communications will begin.

Space Timetable. Communications satellites will bring about profound changes in our everyday lives. These pioneering accomplishments are coming soon:

- Before another year goes by, television signals will probably have been transmitted back and forth across the Atlantic.
- By 1961, the Signal Corps will have enough *Project Courier* satellites in orbit to form a regular communications system between our far-flung military outposts around the globe. This system will be *operational* in 1961, not experimental.
- By early 1962, ARPA will have an electronic repeater satellite in orbit at an altitude of slightly over 22,000 miles. Termed a "24-hour" repeater, it will rotate at the same speed as the earth and will appear to hang over one spot on the earth's surface—probably the mid-Atlantic. The thrust rocket designed to hurl this five-ton moon into orbit is under construction.
- By 1962 or 1963, we will be watching live television from Europe.
- By 1970—a short decade away—we will spin the dial and bring in hundreds of stations from all over the world. Bullfights from Spain, exotic dances from the South Seas, floor shows from Paris night spots—all will flood into our living rooms through the magic of satellite video.

These are *not* just dreams. We have all the know-how and resources needed to accomplish every one of these projects *right now*. A crash program to get the hardware into the sky has already started.

Before 1980, there will probably be super communications satellites aloft, operated by crews who commute back and forth from earth by rocket. The illustration on page 41 pictures one of these advanced satellites which is already being designed by Radio Corporation of America.

Communicating *with* satellites themselves is, of course, not new. (See "Telemetering—Vital Link to the Stars," POPULAR ELECTRONICS, Nov., 1959.) Every satellite launched by either the United States or Russia has maintained some kind of radio contact with earth. But this contact has been used only to control the satellite or to report on its operation to ground stations.

Now, we are beginning to use satellites as another link in our regular communications networks. Employed as relay stations a thousand miles or more above the earth, they will enable us to transmit radio, television, teletype, and other signals around the world far better than we could do it any other way.

Early Experiments. The age of space communications was born—by accident—in October, 1958. The scene was Cape Canaveral. As Pioneer I streaked skyward, headed for outer space, the ground station signaled the rocket to fire its next stage. But something went wrong. Repeated signals to fire somehow got channeled into the missile's transmitter and were relayed to half the world before the space vehicle destroyed itself.

A few months later, satellite communications of a more reliable type went into operation with the launching of *Project Score*. The most publicized feat of *Score* was the broadcasting of President Eisenhower's 1958 Christmas message to the world. But

THE NECESSITY FOR SATELLITE COMMUNICATIONS

Ultra-high-frequency signals—the kind used for television—travel only in straight lines. They do not follow the curvature of the earth and therefore cannot be picked up more than a few miles from the transmitter. Even the 1000-foot towers now used by some television stations increase the maximum range to only a few hundred miles. But a satellite, since it can "see" a large part of the earth, would give vast coverage with u.h.f. signals.

Why must we use u.h.f.? Why not transmit TV by "short wave"—the kind used by some radio communications? The answer: there simply isn't room. A voice signal uses a very narrow channel, only a few thousand cycles wide. But television takes at least five million cycles.

Even if we forget television, we still have a serious problem. The volume of overseas communications has grown so rapidly that we are running out of channels. International Telephone and Telegraph Company estimates that the message load will be seven times as large in 1970 as it was in 1950. By 1963, *all* presently available channels will be jammed to capacity. The only answer is more channels, and the only ones still available are in the u.h.f. range. This means that satellite communications systems must be developed quickly.

it performed a series of more valuable experiments as well.

As *Score* circled the earth, Signal Corps engineers sent aloft radio and teletype messages that were received and recorded by the satellite, then played back on command to other stations thousands of miles away. When ground stations were within two or three thousand miles of each other, the satellite relayed the message instantaneously, without recording it first.

Communications in which the satellite is a *passive* element and acts as a mirror, rather than as a relay station, have also been successful. The spent rocket case that propelled *Score* into orbit was used by RCA for successful "bounce" communications tests. In addition, signals have been bounced off the moon repeatedly in the last few years.

Civilian Projects. Although various systems could be used in world-wide networks, most space experts feel the so-called "24-hour" *active* satellite repeater (the type scheduled to be launched by ARPA in early 1962) offers the greatest promise. This advanced type may actually be the first to go into use for civilian TV. There is even some chance that a civilian-built active satellite repeater will be in orbit *before* ARPA's military version.

Dr. James C. Fletcher, president of Space Electronics, Inc., of Glendale, California, says there is no reason why such a satellite could not be in operation within two years. He estimates it would cost from $25,000,000 to $40,000,000. Dr. Henri G. Busignies, president of International Telephone and Telegraph Laboratories, says it might cost slightly more. But both men think it would pay its own way.

Forty or fifty million dollars may sound like a lot of money. But the recently completed Atlantic cable cost $40,000,000, and can only handle about 50 telephone conversations at one time. It cannot, under any circumstances, transmit a live television program. The satellite proposed by Space Electronics would carry 250 telephone conversations simultaneously—five times as many as the cable—or 125 telephone conversations and one television signal.

Although enthusiasts like Dr. Fletcher are ready to begin the project now—efforts to round up financial backing are under way—other communications industry leaders feel that since NASA plans to fire a 24-hour satellite repeater in 1962, it would be better to wait and profit from this experiment. So the timetable for the launching of a space outpost for civilian TV is uncertain.

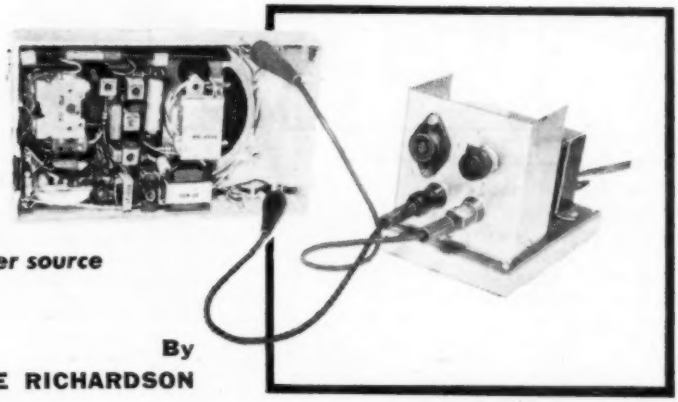
Looking to the Future. Exactly how will satellite communications affect our everyday lives? Imagine the year as being 1970—just ten years away. Hundreds of satellites of every nationality are now soaring through the skies, pouring down torrents of information, entertainment, propaganda. You turn on the TV set and bring in the BBC or Moscow just as clearly as you received home-town stations back in 1960.

Since there are thousands of channels and since each has a potential audience of billions of people, it has now become practical to televise programs of interest to

(*Continued on page* 130)

Half-Amp Variable Transistor Bench Supply

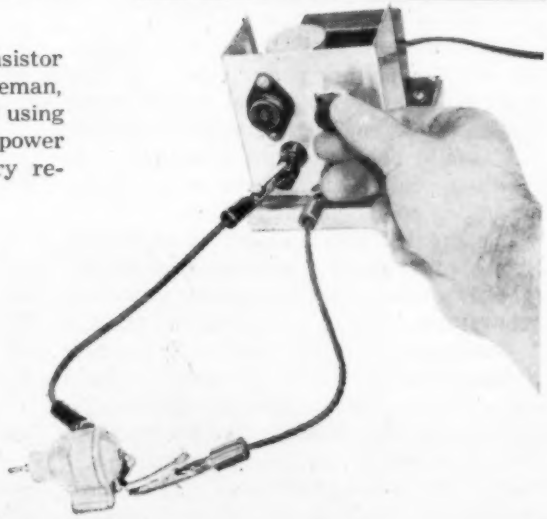
Replace your test bench batteries with this multi-purpose line-operated d.c. power source

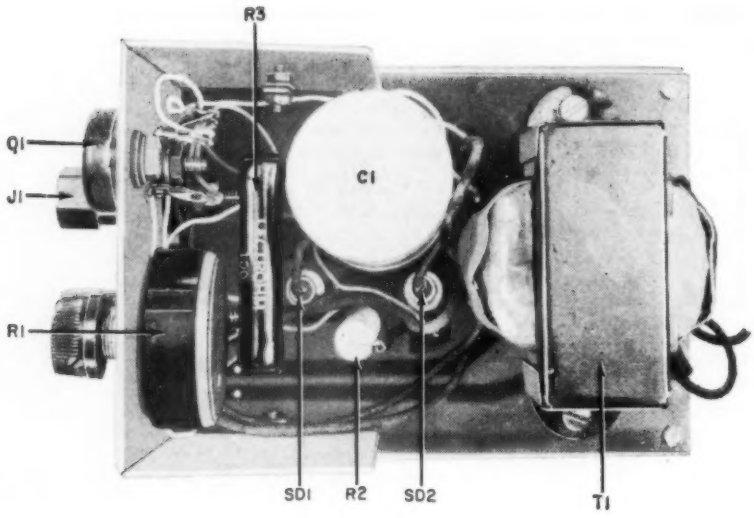


By
EUGENE RICHARDSON

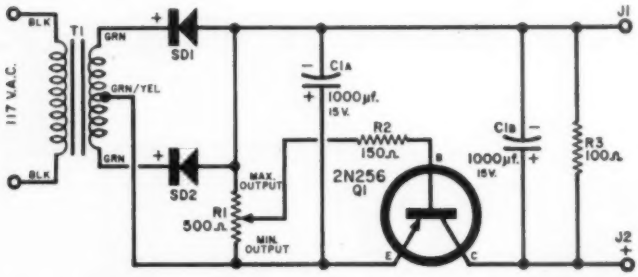
NEARLY everyone working with transistor circuits—whether student, serviceman, gadgeteer, or design engineer—starts by using standard batteries as experimental power sources. The need for constant battery replacement soon becomes a problem, however. The natural solution is to equip your test bench with a line-operated d.c. supply, preferably one with a continuously adjustable output from 0 to 12 volts at currents up to 500 ma.

Here is just such a unit. It can be assembled from standard, readily available components, and wired





Front panel of power supply serves as heat sink for power transistor Q1. Output binding post J2 is below R1.



Power rating of transistor is well above maximum output of supply. Use diodes specified or any replacement types with at least a 500-ma. current rating.

by the average hobbyist or lab technician in just one or two evenings.

Construction. As is typical of power supply circuits, neither parts layout nor lead dress is critical. An etched circuit board similar to the one in the author's model or a Masonite panel (requiring conventional "point-to-point" wiring) may be employed, depending on individual preferences.

The circuit board is supported on a short length of U-channel aluminum stock attached to the board with standard machine screws and nuts. A U-shaped 3¼" x 3¼" x 2" bracket cut and formed from scrap aluminum serves as a front panel and support for output control *R1*, power transistor *Q1*, and the output binding posts (*J1* and *J2*). This bracket is attached to the circuit board with small spade bolts and nuts.

Be careful not to ground *Q1* to its mounting bracket; use a power transistor insulating socket such as the Motorola MK-10. With the wiring completed, double-check all connections before you plug the unit into a line receptacle, paying particular attention to the electrolytic capacitor and rectifier polarities.

Operation. First turn control *R1* to its *minimum* output position (control arm at "emitter" side). Plug in the line cord and

PARTS LIST

C1a/C1b—Dual 1000-μf., 15-volt electrolytic can capacitor (CD B0040 or equivalent)
J1, J2—Five-way binding posts (one red, one black)
Q1—2N256 power transistor
R1—500-ohm, 2-watt potentiometer
R2—150-ohm, 10-watt resistor
R3—100-ohm, 10-watt resistor
SD1, SD2—Silicon diode rectifier (Sarkes-Tarzian Type 10K or equivalent)
T1—Power transformer; 117-volt primary; 26.5-volt CT secondary, 600 ma. (Thordarson 21F27)
1—5¼" x 3½" etched circuit board or perforated Masonite board
1—Length of ¼" x ½" aluminum U-channel stock (see text)
1—3¼" x 3¼" x 2" aluminum bracket (heat sink)
Misc. wire, hardware, transistor socket

connect the device to be powered across *J1* and *J2*, carefully observing polarity. A d.c. voltmeter can be connected across the output terminals to check output voltage, while current drain can be monitored by connecting a milliammeter in series with the output jacks. Voltage control *R1* is now advanced until the desired output voltage is attained.

If the instrument is used at maximum current output (500 ma.) for a long period, the power transistor may become slightly warm. This does not indicate trouble. The 2N256, in this application, is used well below its maximum ratings. In addition, the aluminum mounting bracket serves as an effective heat sink and will prevent dangerous overheating.

Applications. This transistorized power supply can be used in *any* experimental application requiring d.c. voltage within its maximum current ratings. A small overload is permissible for short intervals. It will serve equally well as a test source for breadboard or experimental circuits or as a "battery eliminator" for servicing transistorized receivers, preamps, or hearing aids.

It can be used in such "non-electronic" applications as light-duty electroplating, as a variable power supply for controlling small d.c. motors, and to power small electromagnets and solenoids. Or a useful variable intensity light source may be assembled by connecting it to a standard pilot lamp; such a light source has many applications in microscopy, physics, and optics experiments.

After you work with this handy power supply for a while, you will soon discover dozens of "off-beat" applications in which it can be used. -30-

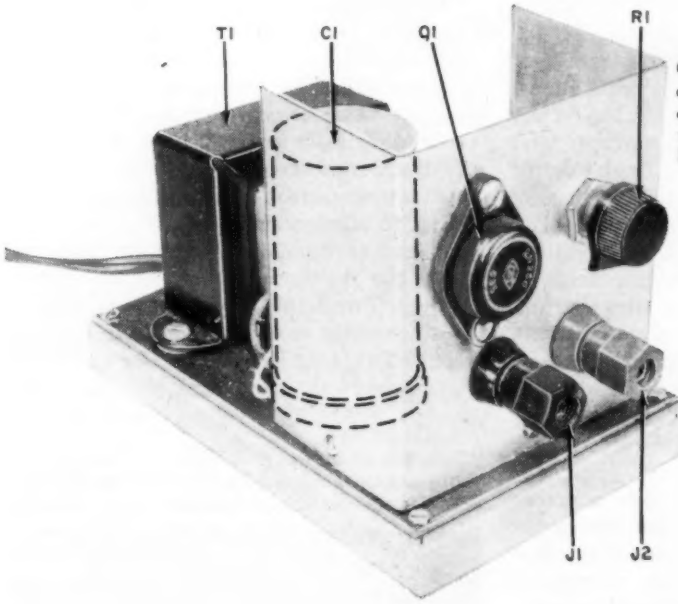
HOW IT WORKS

Line voltage is stepped down by transformer *T1* and applied to a pair of rectifiers (*SD1*, *SD2*) in a full-wave circuit. The resulting pulsating d.c. is applied across input filter capacitor *C1a* and voltage control *R1*.

In operation, *R1* serves to supply base bias to power transistor *Q1* and is used as a combination control and filter element. The bias, applied to the base through current-limiting resistor *R2*, has a small ripple component which is out of phase with the ripple appearing across the emitter-collector circuit, tending to reduce over-all ripple to a minimum. Further filtering is provided by output capacitor *C1b*.

Bleeder resistor *R3*, across the output terminals, has several functions. By providing a small current drain, it helps insure good regulation. At the same time, it serves as a fixed collector load, permitting the output voltage to be reduced to zero even under fairly small external loads. Finally, it serves to discharge output capacitor *C1b* when the instrument is disconnected, preventing the accidental application of a higher than desired voltage to experimental circuits.

Note that the emitter-collector resistance and bleeder resistor *R3* form a simple voltage divider. As base bias is increased by turning *R1* towards its negative terminal, the emitter-collector resistance drops, increasing available output voltage.



Chassis base used for the power supply is fabricated from U-channeling. You can use a conventional metal chassis or a breadboard type layout if desired.

Unusual Tape Recorder

Uher "Universal" offers many unique features

THE Uher "Universal" tape recorder is one of the most cleverly designed recorders we've ever seen. This West German unit has so many unusual mechanical and electronic features that it would take a small book to cover them fully.

To begin with, the "Universal" is a monophonic recorder intended primarily for dictation. It operates at three speeds: 3¾ ips, 1⅞ ips, and 15/16 ips. The sound quality at the ultra-slow speed of 15/16 ips is surprisingly good. Voices are clear and immediately recognizable, and only relatively well-trained ears will detect flutter—partly because a hysteresis motor helps minimize speed variations.

For practically any voice-recording purpose, the 15/16 ips-speed should be completely satisfactory—so good, in fact, that most users will probably seldom use the 1⅞-ips intermediate speed. The great advantage of the 15/16-ips speed is, of course, that it allows a total of eight hours of recording to be put on a single 5" reel of standard tape. The 3¾-ips speed is suitable for high-quality voice recording or for background music.

Mike Switch. One of the "Universal's" most attractive features is the slide switch that is mounted on the microphone. It allows the operator to record, stop, rewind, and play back at the flick of a thumb. This switch seems to be quite foolproof—as does the recorder itself. Of course, the Universal has the usual complement of switches and controls on the chassis of the recorder as well as on the microphone.

Other unusual features include a voice-music switch for playback, an automatic volume control switch for recording (this prevents overloading), and an automatic playback function which allows a tape to be played and replayed automatically.

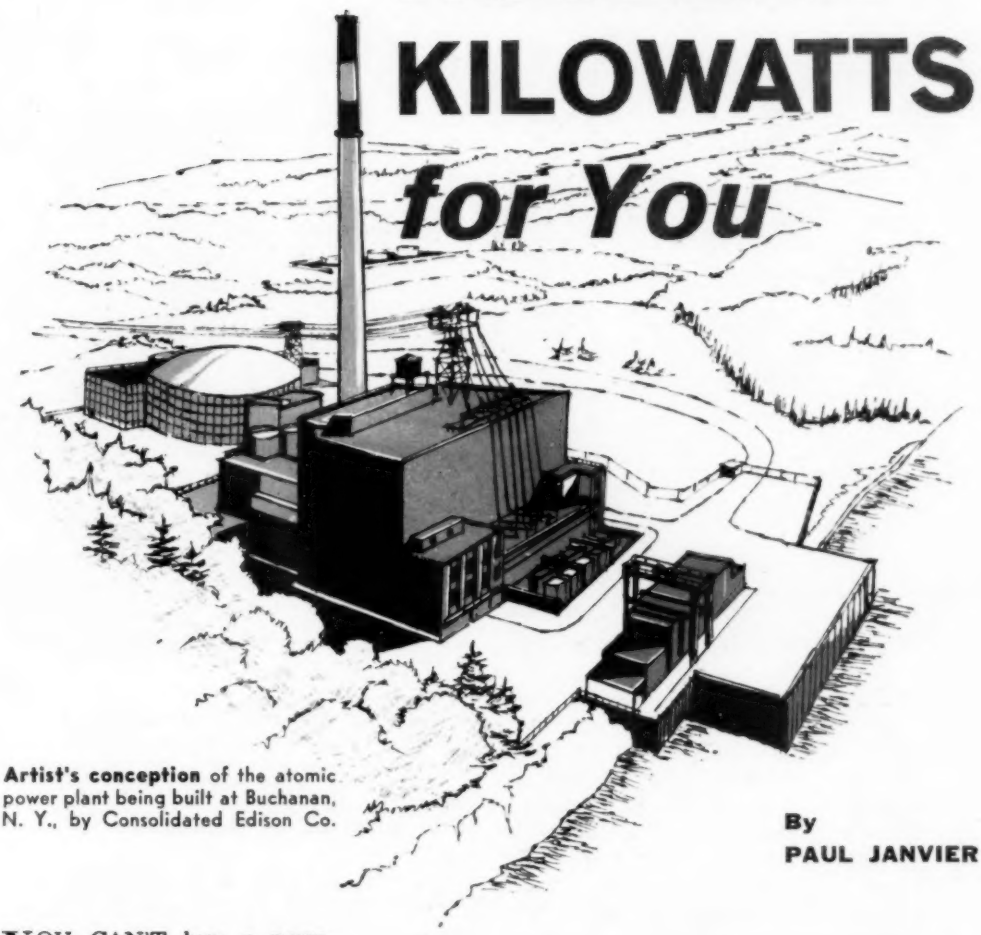
Several accessories for the "Universal" are available, the most interesting of which is called the "Synchro-Akustomat." This little black box plugs into the recorder and provides two functions. First it acts as a sound-actuated record-off switch. When you start talking, the recorder starts recording—losing only the first syllable—and stops recording about four seconds after you have stopped talking.

Slide Projection. The "Akustomat's" other use is in connection with automatic slide projectors. As the operator projects a series of slides, he records his narration and uses the "Akustomat" to put subsonic tones on the tape each time he changes a slide. In playback, the recorder provides the commentary and gives the slide projector the signal to change the slide. Thus, the operator has to do nothing but sit back and enjoy the show.

The "Universal" is priced at $299.95 (with carrying case and mike) plus Federal Excise Tax, sold in U. S. by Warren Weiss, 1650 Broadway, New York, N. Y. —30—

"Synchro-Akustomat" is used as a sound-actuated record-off switch and as a means of synchronizing recorded commentary with automatic slide projectors.

NUCLEAR KILOWATTS *for You*



Artist's conception of the atomic power plant being built at Buchanan, N. Y., by Consolidated Edison Co.

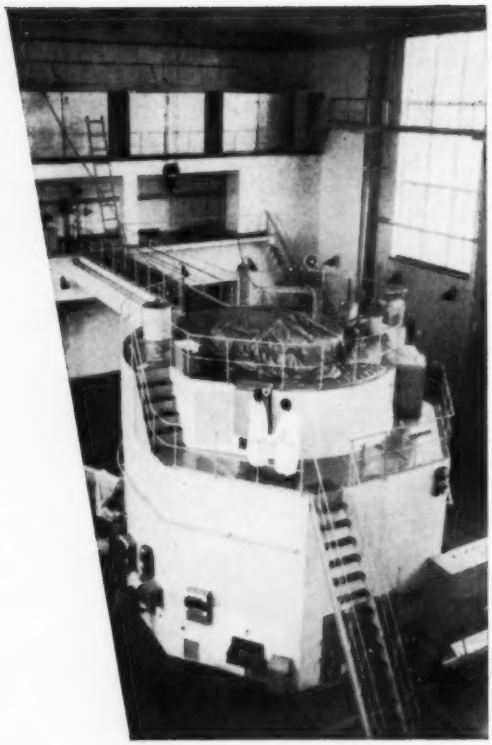
By
PAUL JANVIER

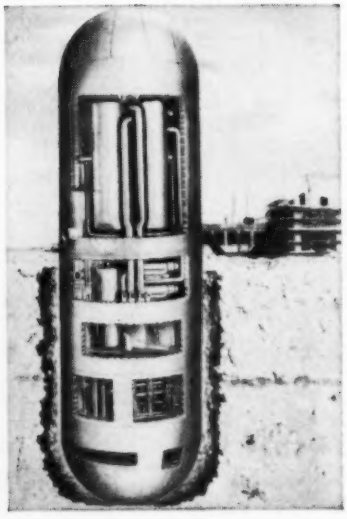
Though present ways of generating electricity from atomic energy are uneconomical, nuclear-powered electrical generators continue to be built—here's how and why

YOU CAN'T buy a newspaper today without finding "atom" news in it. Every day, it seems, an atomic submarine is launched, or another electric power company is building an "atomic" plant. Or word comes from Washington announcing a new program of peaceful uses for atomic energy. There's no doubt nuclear power is here to stay. By 1980, the Atomic Energy Commission predicts, the amount of nuclear-generated electricity in the United States will very likely be as high as the amount generated today by conventional methods.

All this has led to a host of new terms and concepts creeping into the morning news. In some way, we are told, a "chain reaction" within a "critical mass" of "fissionable material" contained in an "atomic reactor" produces power. All right—but how? The papers say that Consolidated Edison of New York is building a reactor? Okay, but what the heck is a "reactor?"

Energy Extraction. Actually, a reactor is a machine that extracts the energy which was put into radioactive materials at the time the universe was created. Reactors can be big, they can be small, they can look a dozen different ways on the outside—but what goes on inside the reactor's shield of concrete, lead, or other protective materials





Atomic reactors are under construction in all parts of the civilized world. In photo at upper left is the first reactor to be built in Poland. Presumably Russian-designed, it appears to be patterned after the English-built Calder Hall reactor, one of the earliest designs. (Eastfoto)

Being erected in Germany near Frankfurt-am-Main is a 15,000-kilowatt boiling-water reactor. This design eliminates heat exchangers since the coolant drives steam turbines directly. The reactor is partly underground for reasons of safety.

other as well. This is because a reactor produces heat just by running itself, and it runs itself by the radioactivity in its fuel.

It's time we talked about radioactivity. What is it? Well, depending on how much a man wants to know about it, he can spend one, two, or even more lifetimes in the study of atomic structure and the forces that determine it. On the other hand, what a man has to know to get power from the atom is what the neutrons are doing.

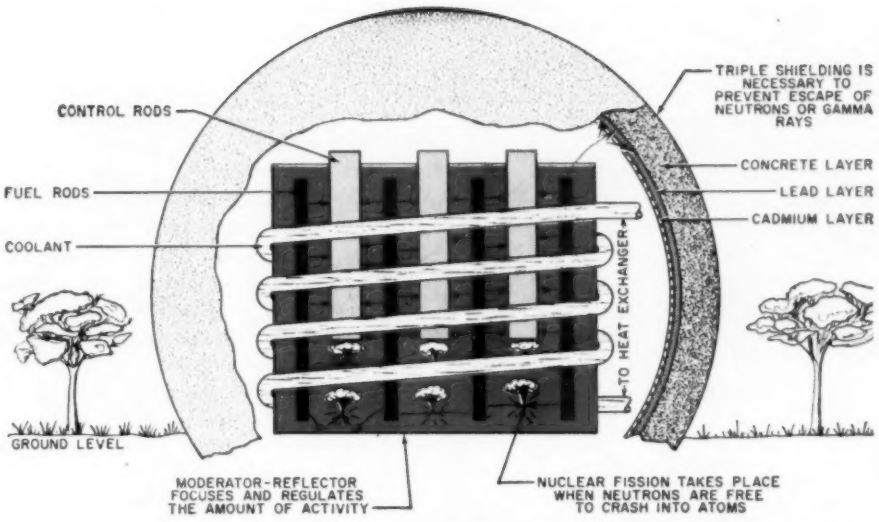
Neutron Emission. It took several lifetimes just to find the neutron in the atom's core (nucleus) where it joins with another atomic component called the proton in the formation of the nucleus. The neutron is a great traveler, zipping away from the nuclei of the unstable, heavy atoms at fantastic speeds. If heavy atoms did not jettison neutrons, their nuclei would come apart. This neutron emission is what makes reactors possible.

To the neutrons, the space between atoms seems vastly empty. In the normal course of emission from naturally radioactive material, the neutron escapes into the non-radioactive world. But in a refined and artificially assembled mass of some "fissionable" element such as uranium, the neutron falls victim to the law of averages: when enough fissionable material is gathered together—and the amount of the minimum or "critical" mass can be precisely calculated—sooner or later the neutron is bound to collide with a nucleus as unstable as the one that gave it birth.

At the impact of the neutron, the nucleus breaks up—or "fissions"—into several lighter nuclei and two or three unattached neutrons. These "free" neutrons spray away and collide with other nuclei, causing them to break up and give off more neutrons as they react to the impact. In no time at all, a "chain reaction" sweeps

is always roughly the same: radioactive phenomena is being manipulated.

There are only two things you can get out of a reactor: radiation, for research purposes or industrial and medical products and processes; and heat, for conversion into conventional energies—usually electricity. No matter which of these things a reactor is designed to do, it'll do a great deal of the


TRIPLE SHIELDING IS NECESSARY TO PREVENT ESCAPE OF NEUTRONS OR GAMMA RAYS
CONTROL RODS
CONCRETE LAYER
FUEL RODS
LEAD LAYER
CADMIUM LAYER
COOLANT
TO HEAT EXCHANGER
GROUND LEVEL
MODERATOR-REFLECTOR FOCUSES AND REGULATES THE AMOUNT OF ACTIVITY
NUCLEAR FISSION TAKES PLACE WHEN NEUTRONS ARE FREE TO CRASH INTO ATOMS

Primary elements of a nuclear reactor are indicated above. The main control over the amount of neutron activity is exerted by the control rods, which can be raised or lowered between the fuel rods. This diagram closely follows the early graphite-moderated design.

through the "critical mass" in a lightning series of "nuclear fissions" which convert the entire mass into a cloud of fiercely hot, violently expanding gases.

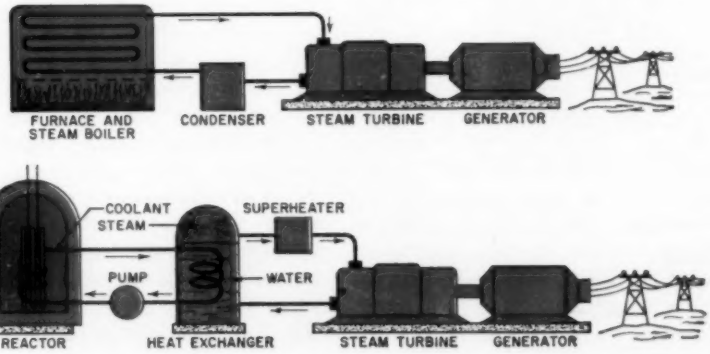
Harnessing the Reaction. Obviously an atomic bomb doesn't generate useful power. What we want is a slow, controlled break-up of fissionable material so we can puts its heat and radiation to work. So we take our critical mass—separated carefully into safe, subcritical masses—and place it inside a reactor.

A reactor's job is to control the chain reaction. It regulates its intensity, channels it, and puts it to useful work. This the reactor does by means of five essential design components.

The *moderator* is composed of a mass of stable materials. It surrounds and sometimes penetrates the core of the reactor (which contains the fissionable "fuel"). The stable atoms of the moderator are, in effect, a sea of mud through which the neutrons shot out by the fuel must slog. The neutrons rebound from the stable nuclei of the moderator and are more likely than ever to bounce and spin into the unstable nuclei of the fuel atoms.

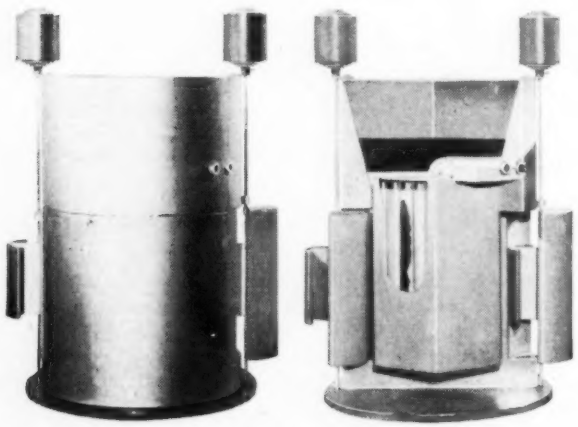
What the moderator does is encourage neutron collisions at an even rate. Graphite

So-called "atomic power plants" are actually furnaces which produce steam for driving electrical generators. Comparison of a conventional electric power generating system with an "atomic" system shows that once the water is hot, the two systems are identical. The superheater in the lower diagram is powered separately and simply gets the steam even hotter.



is still the old standby as a moderator. When Enrico Fermi and his associates built the world's first reactor, they literally stacked graphite bricks around the fuel core—which is why the familiar, huge, square-faced thermal reactor is still called an "atomic pile."

But, having encouraged neutron collisions, the reactor now has to be able to stop what it has started—or, at any rate, to slow it down. This is done with *control elements*. In one type of reactor, these are long sliding rods thrust into the pile. Depending on how far these rods are eased into the core among the fuel elements, they absorb greater or lesser numbers of neutrons, and so control the speed of the reaction. They're made of, or contain, elements which don't simply reflect or impede neutrons the way the moderator does, but actually have room in their atomic structure to pack away extra neutrons.



External and internal views of the SNAP II, a compact reactor designed for use in space. The 50-kilowatt unit weighs 220 pounds and is about the size of a five-gallon milk can. It operates in conjunction with a miniature heat-exchange system and a turbo-electric generator the size of a football. The two protrusions at the top are the control drive motors.

Boron steel or cadmium is generally used for control elements—and for the *shield* which jackets the reactor. Should some neutrons manage to get out of the core, they are stopped by the shield before they can do damage to the outside world.

So, by smoothing the reaction with the moderator and keeping it to a safe level with the control rods, the reactor handles the energy seething inside it.

Another design component is the *reflector*. Like the moderator, it surrounds the core. Its job is to bounce back any stray neutrons before they can get to the shield. Many reactors double up and use the moderator as the reflector, just as the control rods, in a way, are a maneuverable extension of the shield.

Heat Transference. No part of any working atomic reactor has had more thinking devoted to it than the fifth and last component: the *coolant,* which circulates around—or through—the core and the adjacent reactor components, and carries off the heat. In order to do this, it has to be a fluid which (1) resists neutron absorption, (2) won't corrode the pile components or the "cans" in which the fuel is packaged, (3) can be pumped easily through the reactor, and (4) should easily absorb and give off heat so that it can be recycled quickly.

This is a tall order, for it's practically impossible for a coolant to do all of these things well at the same time. Depending on the particular reactor, the fluid used can be anything from carbon dioxide gas to such tasty beverages as liquid sodium, benzine, boiling water, and water under 2000 pounds pressure to keep it from boiling.

Provided that the reactor's purpose permits such a design, the coolant can also serve as the moderator. Also, there's an ingeniously designed reactor that has a fuel component doing double duty as the coolant.

But where is all this ingenuity getting us? We talk about atomic power. All we've got so far is either a source of heat or a second cousin to an atomic bomb. How do we get the power out of the reactor? Where's the spigot?

Here's how an atomic reactor delivers electricity: the coolant circulates through the structure, picking up heat generated by the controlled atomic fission. It carries the heat into a *heat-exchanger,* which is basically two tubes lying side by side in an insulated jacket. One carries circulating coolant from the reactor. The other is a cold water line which picks up the coolant's heat—but *not* its radioactivity—by simple

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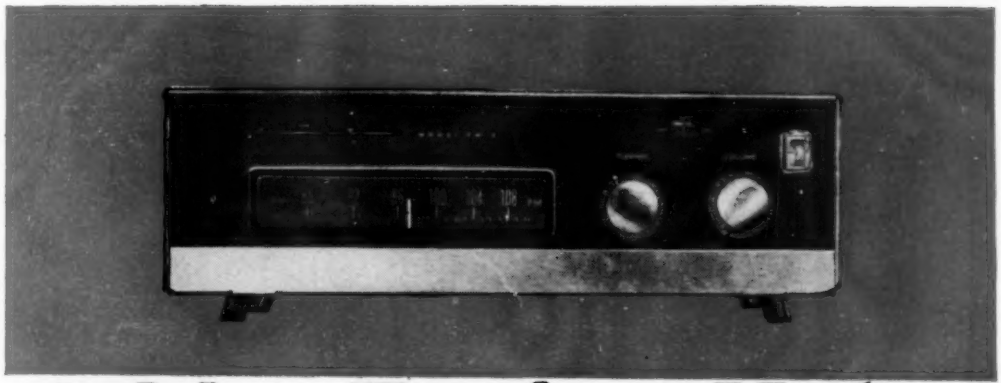

Add a Tuning Meter to your FM Receiver

ANYONE brought up in the radio and TV era feels quite confident that he can tune in an FM radio station properly. But this is not always the case.

Many people believe that a station will come in perfectly when the tuner is tuned to any point where the noise "behind" the station disappears. This method, however, places full responsibility for accurate tuning on the ear of the listener. And even a listener with "golden" ears doesn't consciously notice the small amounts of distortion which creep in when the station is not tuned precisely. The end effect is a case of "listener fatigue."

The answer to this problem? Easy: a tuning meter. It will allow each station to be turned on the nose! Here's how: when a station is tuned in correctly, the detector's d.c. output voltage as read by a d.c. meter movement will be zero. When the station is detuned, a d.c. voltage will appear at the audio output. This voltage will be either positive or negative, depending on which side of center the set is tuned.

Don't think it's a big operation to install a tuning meter; it's not. Here's how a tuning meter was added to one popular FM tuner, the kit-built Heath Model FM-4.

Modification. The first step in modifying the Heath FM-4 is to remove the cover and the bottom plate. Then remove the receiver's knobs and the mounting nut and flat washer from the volume control shaft.

Before removing the front panel, mark off the position of the tuning meter to be installed (Lafayette TM 13 or equivalent) on the rear surface of the panel. If this is not done, the meter may jam against the plate which mounts the a.f.c. switch. Now remove the front panel.

A ½" (horizontal) by ¾" (vertical) rectangular hole is required. It is drilled with a ⅜" bit and a triangular file is used to trim off the excess metal until the meter fits snugly in the hole. See Fig. 1.

The easiest way to mount the meter is to glue it in place using Duco cement. After this is done, suspend operations until the cement hardens completely. Then remount the front panel but do not install the cover.

Connect a 75,000-ohm, 1-watt resistor between the upper meter

Fig. 1. Meter is glued into hole on front panel of FM tuner.

By LOU GORDON

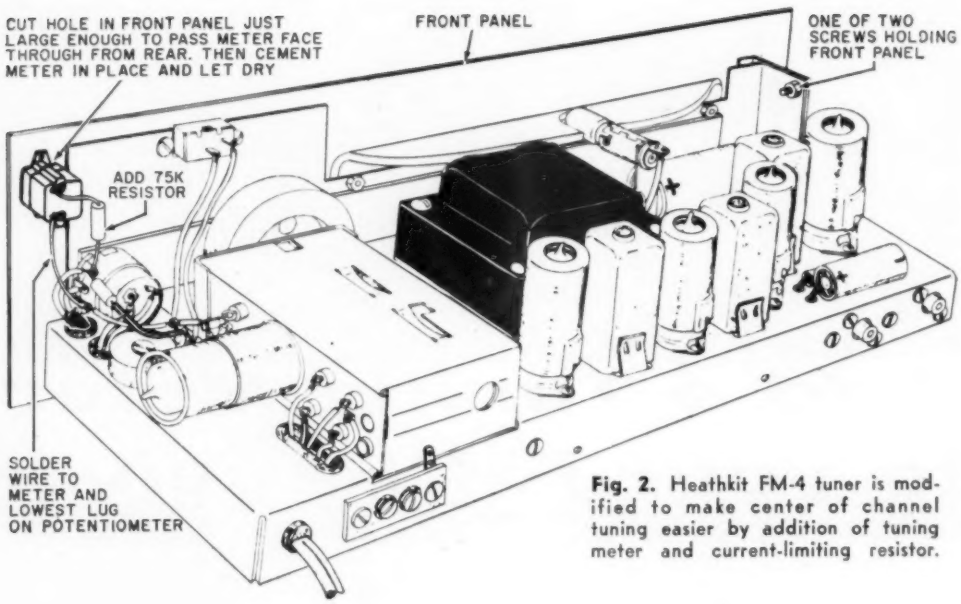
CUT HOLE IN FRONT PANEL JUST LARGE ENOUGH TO PASS METER FACE THROUGH FROM REAR. THEN CEMENT METER IN PLACE AND LET DRY
FRONT PANEL
ONE OF TWO SCREWS HOLDING FRONT PANEL
ADD 75K RESISTOR
SOLDER WIRE TO METER AND LOWEST LUG ON POTENTIOMETER

Fig. 2. Heathkit FM-4 tuner is modified to make center of channel tuning easier by addition of tuning meter and current-limiting resistor.

terminal and the highest terminal on the volume control, as in Fig. 2. Solder both connections. Do *not* disconnect the green wire and the 1-megohm resistor already connected to this terminal.

Now connect an insulated wire from the meter's lower terminal to the lowest terminal on the volume control. Keep this lead short. Do *not* disconnect the black wire and the braid of the shielded cable which are connected to this volume control terminal. Then solder both ends of the added wire.

Tuning. Connect the tuner into your hi-fi system. Before applying power, note the meter pointer's center position.

Turn on the tuner and let it warm up for a few minutes. Now slowly tune through a strong station. Note how the pointer rises above the zero position, crosses through zero when the station is loud and

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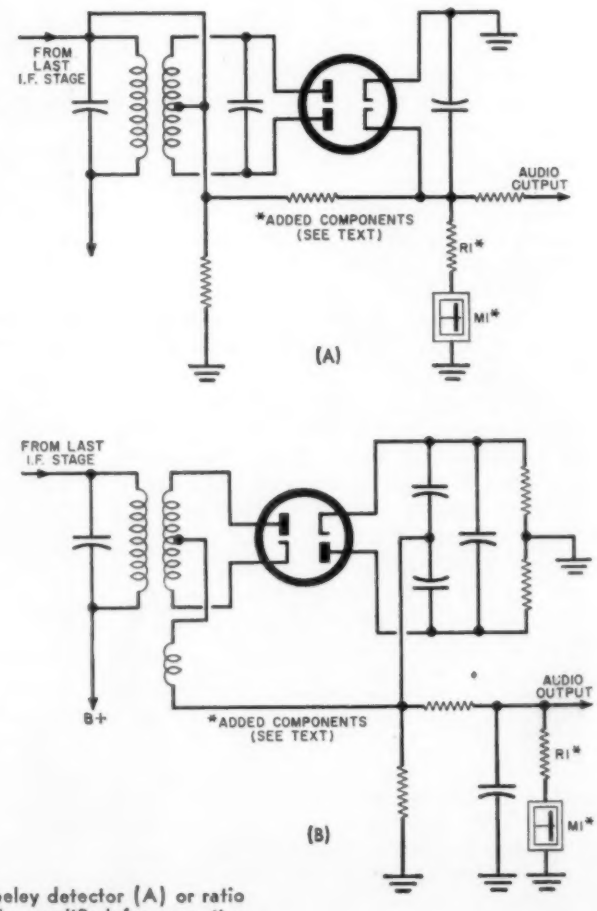
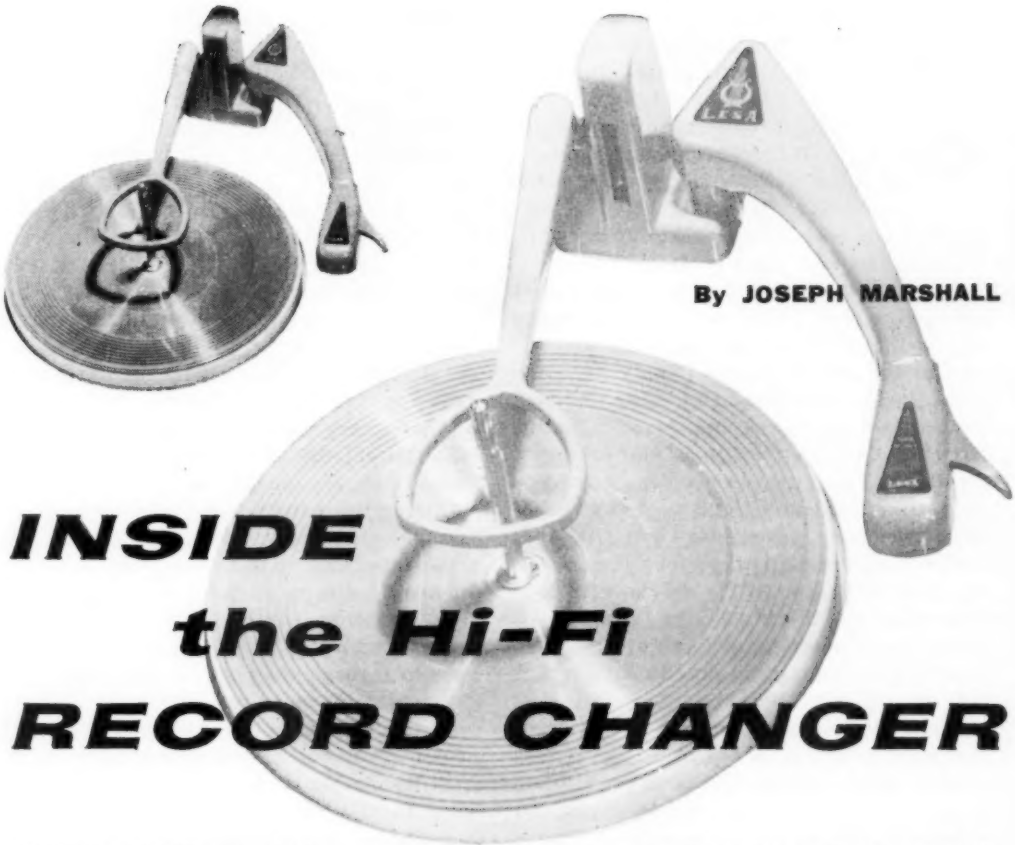


Fig. 3. FM tuners using popular Foster-Seeley detector (A) or ratio detector (B) as in Heathkit FM-4, can be modified for operation with a tuning meter. Note added meter and resistor in each circuit.



By JOSEPH MARSHALL

INSIDE the Hi-Fi RECORD CHANGER

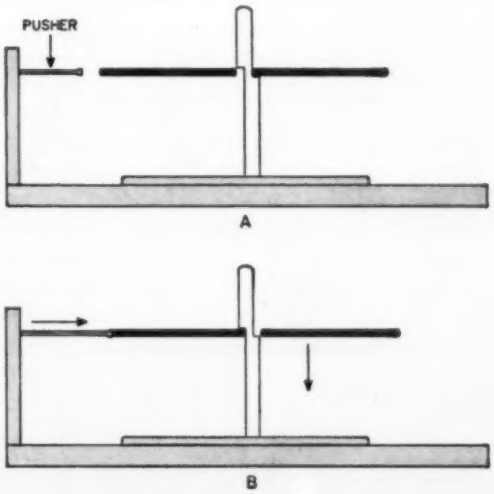
THE MODERN record changer is a real marvel of mechanical ingenuity. Not only does it play a succession of records automatically, but it does the job better than most people can do it by hand.

Dropping the Record. The primary function of the changer is, of course, to play a series of records automatically. Practically all of today's changers use one of two principles to perform this task. The first is the "offset-spindle, pusher type" diagramed in Fig. 1. Here we have a spindle which, instead of being straight, has an offset of half the diameter of the record hole.

When a record is placed on this spindle, it will rest on the platform formed by the offset. See Fig. 1(A). However, if the record is pushed to the right about an eighth of an inch, it will fall off the platform. See Fig. 1(B). Note that there is only enough room for a single record to fit under the notch on the left side of the spindle, so only one record at a time can be pushed off. As the bottom record falls, the next record drops to the platform, ready to be pushed off during the next cycle.

Systems for pushing the record off the platform are of two types: "external pushers" and "internal pushers." In Fig. 1, a pusher external to the spindle moves forward to contact the edge of the record and then pushes it off the platform. "External

Fig. 1. Simplest record-dropping system is the "offset-spindle, external pusher" type shown here.



pusher" systems are used in the Garrard RC88 and in the Thorens CD43 changers.

The record can also be pushed from the inside of the center hole as indicated in Fig. 2. Here we have a triangular cam hinged to the spindle at the bottom and facing a slot in the spindle. Normally, the top of the cam extends upward through the record's center hole. The record is supported by the offset spindle. See Fig. 2(A).

To drop the record, the cam in the center hole of the record pulls the record over the center of the bottom part of the spindle. As soon as the hole is clear of the platform, the record drops. See Fig 2(B). Now the cam moves back to its original position; as the next record comes down on the platform, the cam fits into its center hole, ready to do its pushing job again. This "internal pusher" arrangement is used on a great number of changers, including the Webcor, the V-M, the Glaser-Steers GS-77, the lower-priced Garrards, the Collaro, and the Lesa.

In any "offset-spindle, pusher-type" changing mechanism, a stack of records is not well balanced because the records rest on such a small surface. In the internal-pusher mechanism, a "balance" arm rests on top of the records and thus holds them in place. In the external-pusher types, the spindle is bent to the left and the records are held in place by various systems—a "horseshoe arm" in the case of the Thorens CD43, and a platform-roller arm assembly in the Garrard RC88.

Disappearing Platform. An entirely different way to handle a series of records, which we might call the "disappearing platform" system, is shown in Fig. 3. In the "ready" position, four cams protrude from the spindle and form a platform for the records to rest on. See Fig. 3(A). If these cams are withdrawn into the spindle, the record has no option but to fall. The problem is: how do we arrange matters so only the bottom record falls?

One way is to have the part of the spindle which is just above the bottom record expand slightly, thus gripping the upper records and preventing them from falling. This is the arrangement used in the Miracord XS200 and Dual 1006 changers. As the four cams which support the bottom record withdraw into the spindle, the part of the spindle which is immediately above the bottom record begins to expand. By the time the cams disappear into the spindle, the upper records are held firmly by the expanding spindle. See Fig. 3(B). After the bottom record falls onto the turntable, the pedestal cams come out, the upper part of the spindle contracts, and the whole stack of records moves down one notch.

Still another record-dropping system is used to play the big-hole 45-rpm records. See Fig. 4. Here again we have a set of cams which form the pedestal on which the records rest. Just above them, however, we have some thin, knife-like blades. See Fig. 4(A). As the pedestal cams withdraw into

Fig. 2. "Offset-spindle, internal pusher" record-dropping system is used by many manufacturers, including Glaser-Steers, Garrard, Collaro, and Lesa.

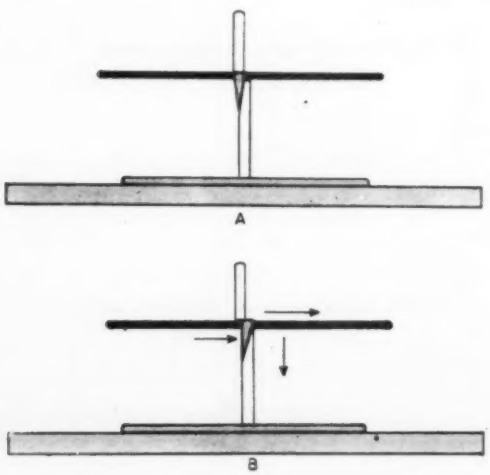
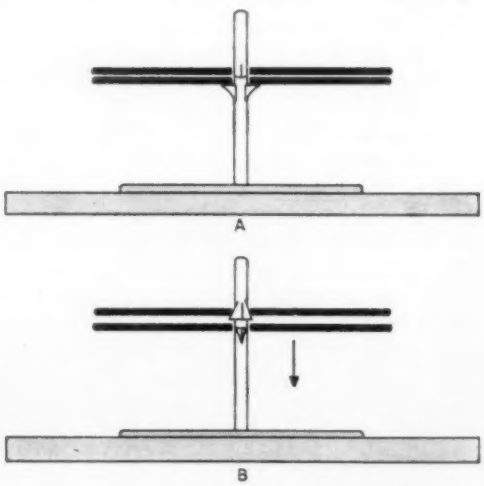
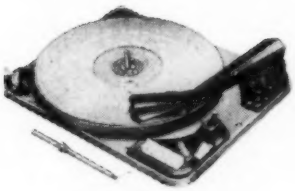
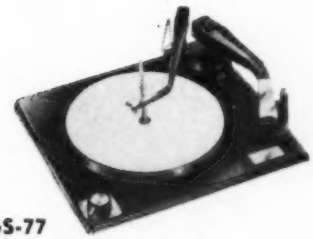


Fig. 3. Here is the way the "disappearing platform" system operates. This technique of dropping the record is used in the Miracord and the Dual.



Dual 1006





Glaser-Steers GS-77

the spindle, these blades move out between the bottom record and the next one in the stack to form a platform that holds the upper records while the lowest one is falling. See Fig. 4(B).

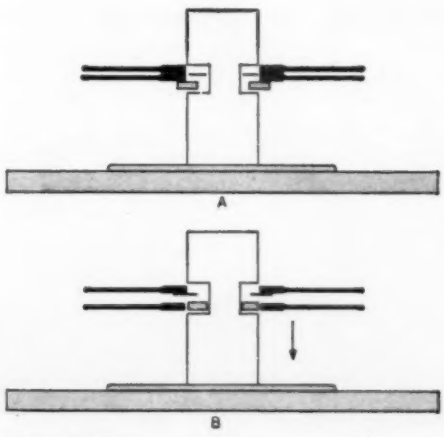
Automatic Intermixing. Once the record has dropped to the turntable, the next step is to swing the tone arm into place so the stylus will come down in the first groove. It wouldn't be too difficult to design a system of gears, levers, and cams that would set the arm down at the same point on every record—but we have three standard sizes of records: 7", 10", and 12". In early changers, a mechanical switch usually provided the indexing needed to bring the tone arm down at the right place on these three sizes of records. But every time a different-sized record was played, the switch had to be operated manually.

Nowadays, most changers can intermix records of different sizes automatically. There are several ways employed to do this. One is to have an additional arm that moves out before the record drops and feels the edge of the record. As the feeler arm moves out, it also moves the indexing levers or cams for the tone arm. When it touches the edge of the record, it withdraws slightly but leaves the indexing cams or levers in place. Then, when the tone arm swings toward the record, it is automatically stopped just beyond the point where the feeler arm contacted the edge of the record. This is the device used in the Garrard changers.

The tone arm itself can be used as a feeler, and the record dropped in two stages. First the record drops an inch or two and is held in place while the tone arm "measures" it. The tone arm then moves back slightly, the record drops the rest of the distance, and the tone arm swings toward the record and comes down in the lead grooves. The Rex and the Dual changers use this method.

On the Glaser-Steers GS-77, the "measuring" is done by a triangle of light bus wire which is attached to the bottom of the tone arm. Before the record is dropped, this triangle moves out over the turntable. As the record falls, it hits the triangle and pushes it back. A 12" record pushes it farther back than a 10" record, and a 7" record misses it completely. Thus, the indexing mechanism of the arm is keyed for the size of the record which has just dropped. The Miracord XS200 has an inclined lever at the foot of the tone-arm post which performs the same function.

Fig. 4. Record-changing system for the 7" 45-rpm records. As the pedestal cams withdraw into the spindle and allow the bottom record to fall, a set of blades keeps the upper records from falling.



Automatic Speed Change. Most modern changers permit intermixing of the three sizes of records providing they are of the same speed. But suppose you would like to intermix 10" and 12" 33-rpm records with 7" 45-rpm records. Would it be possible for a changer to adjust automatically for records of different sizes *and* different speeds? The Glaser-Steers and Webcor changers can do exactly this by a very logical extension of their tone-arm indexing systems.

Bear in mind first of all that all 10" and 12" microgroove records should be played

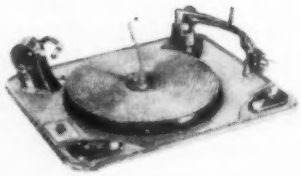
back at 33⅓-rpm; the only records which require the 45-rpm speed are the 7" records with the large center holes. In the Glaser-Steers, as the feeler triangle moves out, it also moves a pin that engages the speed-control slide. In the most forward position, it pulls this slide, engaging the 45-rpm idler. If the feeler arm is not touched by the falling record—and only a 7" record will fail to move it—the turntable is set to play at 45 rpm. But if the feeler arm is moved by either a 10" or a 12" record, the control slide engages the 33-rpm idler. In this way, both 33⅓-rpm and 45-rpm microgroove records can be played in any order (if the 45's have inserts in the center holes).

The Glaser-Steers also incorporates a mechanism which changes the speed from 33⅓ rpm or 45 rpm to 78 rpm when the "78" stylus of a turnover cartridge is in position.

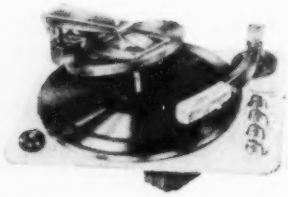
A wide variety of mechanical systems are used to perform the automatic functions of a record changer, and every changer differs in mechanical detail and also in the special features it offers.

Motor Rumble. The rumble problem is far more serious in changers than in turntables. Because of the complicated mechanical system needed to actuate the changing functions, it is not possible to isolate the motor from the tone arm and turntable as completely as in a simple turntable. Nevertheless, most modern changers have generally acceptable rumble figures, and one or two provide performance once only attainable by expensive transcription turntables.

Miracord XS200

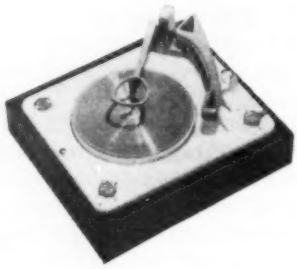


Garrard RC98



Thorens CD43

Collaro TC99

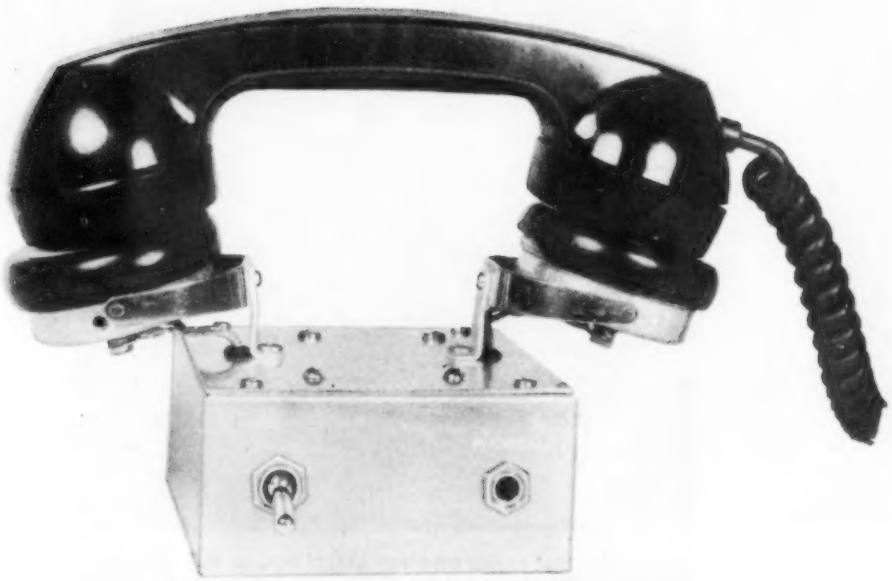


Lesa CD2/21

Rumble figures of changers run from around 30 to 45 db, and anything over 40 db will satisfy anyone but a "golden-eared" audiophile. However, let's face it: you cannot expect a changer to produce as little rumble as do the best turntables. Should you decide to buy a changer, it is wise to choose a speaker that cuts off rather sharply below 45 cycles. Such a speaker will reproduce a good deal of fine bass without reproducing the rumble. Or you can use a rumble filter; but the attenuation slope of a rumble filter is gentler than the attenuation slope of a speaker. Hence a rumble filter will cause the loss of more bass above 40 cycles.

Changers also complicate the selection of the cartridge. To actuate the mechanism, most changers require a stylus pressure of 4 to 6 grams. There are some exceptions—notably the Dual 1006—which operate with very low stylus pressures. High-compliance cartridges do not work well with high stylus pressures; indeed, the high pressure defeats their virtues. Therefore, the best choice is a moderate-compliance cartridge which is recommended by the changer manufacturer or is known to be suitable for the changer.

Although it is devilishly difficult to design a good record changer, the quality of some changers approaches that of transcription turntables. When a quality record changer is used with suitable cartridges and loudspeakers, it can meet true hi-fi performance standards. —30—



ACOUSTIC PHONE PATCH

Build this third-party link between your ham contact and telephone

EVERY HAM realizes that a phone patch can add to the fun and usefulness of his station. A phone patch allows an operator to make a telephone connection between fellow operators and their friends who are in the vicinity. Here is one which is easy to build and needs no connections to telephone wires, thus avoiding possible trouble with the telephone company.

Construction. Basically, this phone patch is a pair of magnetic headphone units mounted so that a telephone handset can rest on them. One headphone unit acts as a microphone and feeds the acoustical output from the telephone through a one-transistor amplifier into the transmitter; the other feeds the output from the receiver into the telephone.

The headphone units (*HP1, HP2*) are mounted 5½" apart (center to center) on a utility cabinet about 4" x 4" x 2". The transistor amplifier is mounted on the underside of the cabinet. Isolation resistor *R3* should be from 10,000 ohms to 2 megohms;

By J. C. FISCHESSER, W4FMW

Typical radio amateur setup showing the telephone handset on top of the phone patch. The YL operator is monitoring the conversation between a contact on the air and a nearby friend on the telephone.

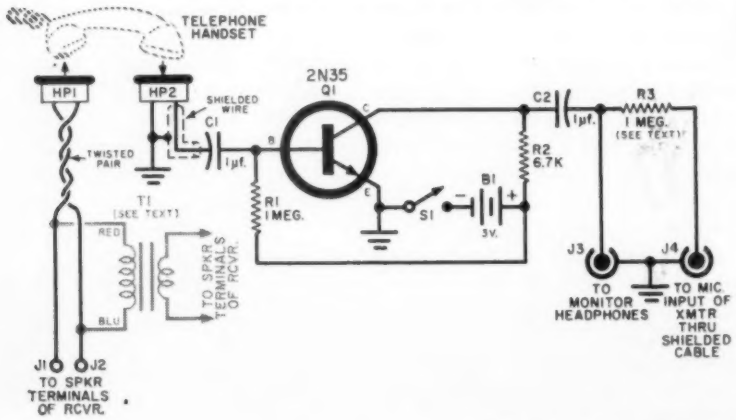
try several values for the best output level at jack *J4*.

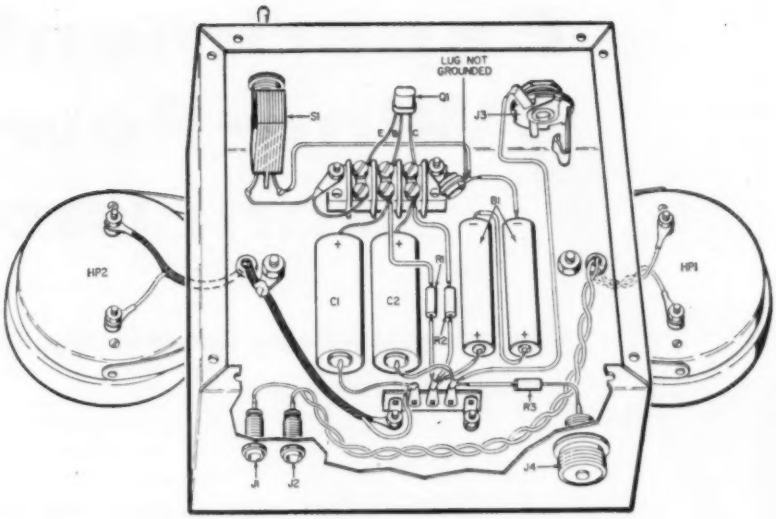
Adjustment. Connect jacks *J1* and *J2* to the speaker terminals of the receiver. Next, turn up the receiver volume to drive headphone unit *HP1*. If the output from *HP1* is too low and the sound from the receiver's speaker is too loud, connect an inexpensive audio output transformer (*T1*) between the speaker terminals and *HP1* to improve the impedance match. The transformer's voice-coil winding should be connected to the speaker terminals and the plate winding to jacks *J1* and *J2*.

Output from the transistor amplifier is fed from output jack *J4* to the microphone input jack of the transmitter via a cable with suitable connectors. This input to the transmitter can be monitored at jack *J3* with a pair of high-impedance headphones.

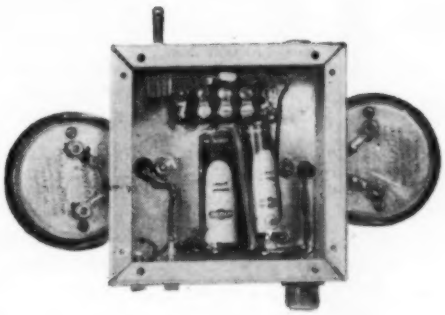
Operation. Place the telephone handset on the phone patch with the mouthpiece

Transformer T1's use is optional. With it, you can increase volume in the headphone unit (HP1) feeding the telephone mouthpiece. Note that the voice of the telephoned party is picked up by headphone unit HP2.





Substitute different jacks in the phone patch to match the equipment plugs in your station. A shielded lead is needed between headphone unit HP2 and capacitor C1.



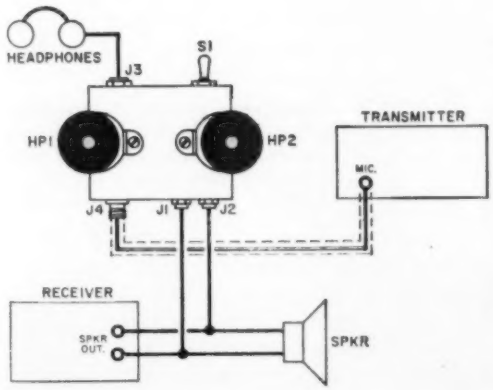
PARTS LIST

B1—3-volt battery
C1, C2—1.0-μf., 100-volt paper or electrolytic capacitor
HP1, HP2—High-impedance headphone unit
J1, J2—Pin jack
J3—Phone jack
J4—Microphone jack
Q1—2N35 transistor
R1—1-megohm, ½-watt resistor
R2—6700-ohm, ½-watt resistor
R3—1-megohm, ½-watt resistor (see text)
S1—S.p.s.t. toggle switch
T1—Replacement-type output transformer; single plate, 2000 to 10,000 ohms; to voice coil, 3.2 to 16 ohms (Lafayette TR-69 or equivalent—see text)
1—4" x 4" x 2" utility cabinet (Bud AU-1083)

against *HP1*. Don't worry if the telephone doesn't fit perfectly against the phone patch headphone units. Quality is actually better if there is a small air gap.

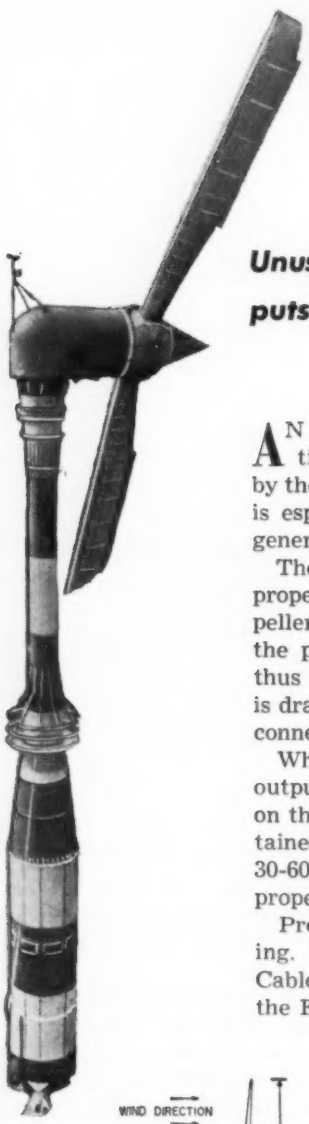
When you close switch *S1*, you should hear the party on the telephone in your monitoring earphones. Adjust the transmitter speech amplifier gain control for the best modulation. Then turn up the receiver volume until the party on the telephone can hear your radio contact at normal telephone volume.

Make a note of the positions of your receiver volume control and the speech amplifier gain control, and you will be able to hook up the phone patch in a jiffy next time. -30-



Hook up the phone patch to the receiver, transmitter, and monitoring headphones as shown. Insert transformer T1 between jacks J1, J2 and the receiver's speaker leads for more volume at HP1.

Experimental Wind-Power Generator



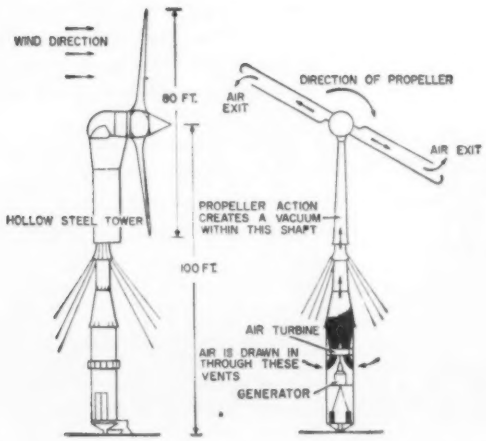
Unusual system being tested in Algeria puts out 100 kilowatts

AN EXPERIMENTAL wind-powered system for generating electricity is being tested and evaluated in Algeria by the British Electricity Authority. The 100-kilowatt system is especially interesting in that the wind is coupled to the generator without any gears or mechanical linkages.

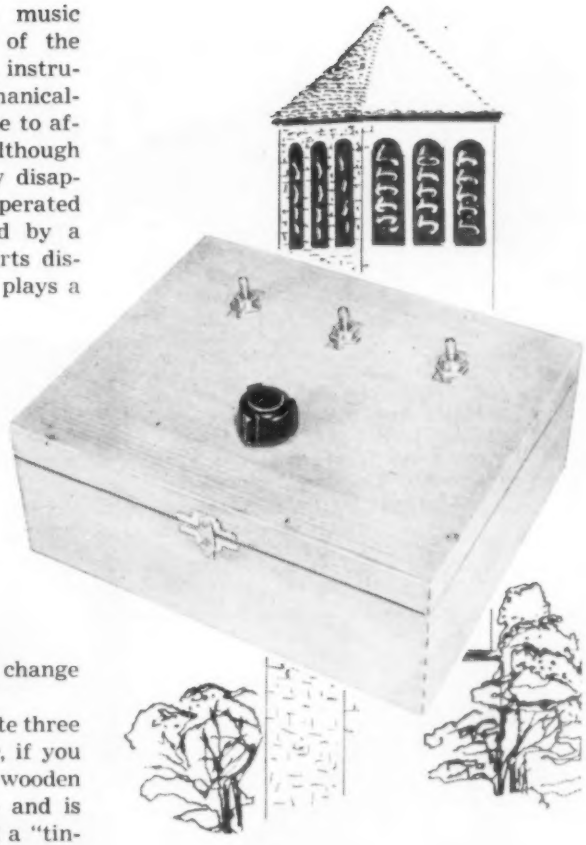
The driven element of the system is an 80′ hollow-bladed propeller mounted at the head of a 100′ tower. As the propeller rotates, centrifugal force throws air out the ends of the propeller. This creates a vacuum in the tower shaft, thus enabling a wind turbine to be driven by the air which is drawn in at the bottom of the shaft; the turbine is directly connected to an electrical generator.

When the propeller turns at a speed of 95 rpm, the rated output of 100 kilowatts is produced. Variable-pitch blades on the propeller allow the speed of the propeller to be maintained constantly at 95 rpm over the wind-speed range of 30-60 m.p.h. Winds from any direction are usable since the propeller is mounted on a pivot.

Preliminary tests of the system have been very encouraging. Built by De Havilland under the direction of Enfield Cables, it was adapted from a design of Monsieur J. Andreau, the French engineer. -30-



Operation of the wind-powered generating system is diagrammed at left. Vacuum in main shaft pulls incoming air through the wind turbine, driving the generator.



Build an Electronic Music Box

You can get "bell-tower" effects from your audio system with this inexpensive unit

By E. G. LOUIS

REMEMBER the old-fashioned music boxes? Before the invention of the phonograph, these unique wind-up instruments were the only source of mechanically reproduced music for those unable to afford an expensive player piano. Although the music box, as such, has largely disappeared from the scene, battery-operated music box movements are stocked by a number of the large electronics parts distributors. Each of these tiny units plays a single 18-note melody and is operated by a miniature electric motor which can run on a single flashlight cell.

For less than $10 and a few hours' pleasant work, you can assemble one or more of these movements into a modern music box which can be played through any standard audio amplifier. Its festive repetitive chime-like quality is perfect for outdoor reproduction on holidays—and there's no need to change records or tapes!

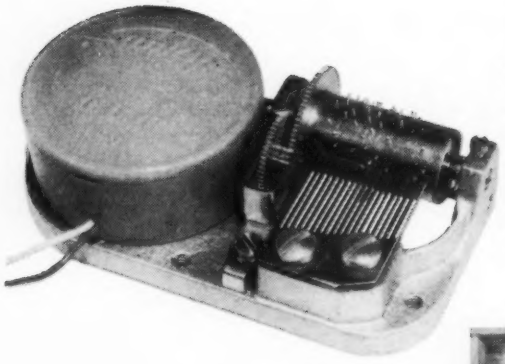
Construction. You can incorporate three movements in the unit as shown or, if you wish, use a single movement. A wooden cigar box makes an excellent case and is preferable to a metal box—to avoid a "tinny" sound. The printing on the box can be spray-painted over or removed by the liberal application of a scraper, sandpaper and elbow grease.

A commercially available contact microphone is used as a pickup. (This is the type of microphone employed with electric guitars and the like.) It is coupled mechanically to the tone plate of each movement. If you use a single movement, attach the contact microphone directly to one of the tone plate mounting screws.

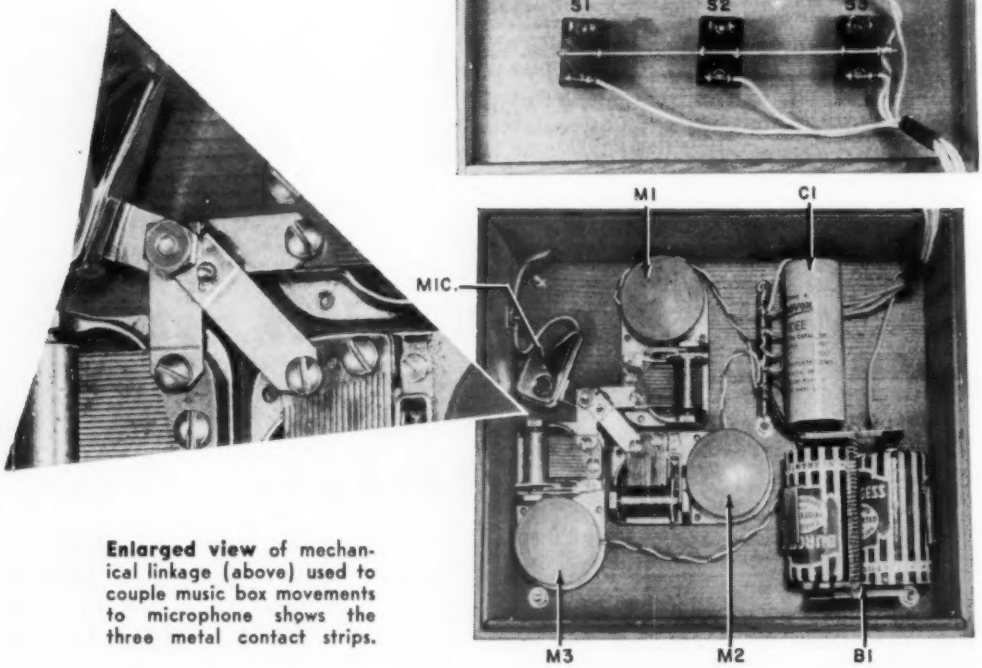
If you use two or more movements, fabricate a coupler from strips of stiff sheet metal. Solder the strips together and attach them to the contact microphone with a standard machine screw and nut. One end of each strip fans out and attaches to a single tone plate, as shown.

Wiring. Each music box motor (*M1, M2, M3*) is controlled by a separate toggle switch (*S1, S2, S3*). Power is supplied by three-volt battery *B1* made up of two flashlight cells connected in series. Series resistance *R1-R2* provides a control over motor speed and permits tempo adjustment. Capacitor *C1* serves as a bypass for electrical noise developed by sparking of the d.c. motor brushes.

There are a number of possible parts substitutions. For example, a 50 to 100 ohm control should be used for speed adjustment, but in the model a 350-ohm control (*R2*) found in the junk box was employed



Music box movement consists of small d.c. motor in round can (above left) and a revolving "pipped" drum which plucks the metal rods.



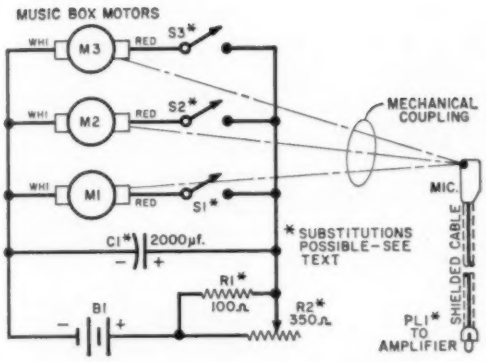
Enlarged view of mechanical linkage (above) used to couple music box movements to microphone shows the three metal contact strips.

Speed control and on-off switches are in cover of the music box (upper right). Movements, capacitors, and batteries are mounted in bottom of box (lower right).

which required a 100-ohm shunt resistor (*R1*). Toggle, slide, rotary or push-button switches can be used for *S1, S2,* and *S3*. Capacitor *C1*'s value is not critical—any unit from 50 to 5000 μf. at from 3.0 to 25 volts or higher will do.

Terminate the microphone cable in a plug (*PL1*) to match the input jack of the amplifier used. Lead dress is not critical but care should be taken to observe d.c. polarities—otherwise the motors will operate in reverse.

Operation. Check all wiring, install the batteries and close switches *S1, S2,* and *S3,* one at a time, while adjusting tempo control *R2*. All three movements can be operated at the same time by turning *R2* to its minimum resistance position. If trouble is encountered, recheck the wiring and make sure there are no cold-soldered joints.



Three movements are shown in schematic of music box at left. A less expensive unit could have only one movement and a single fixed resistor (50 to 100 ohms) for R1 and R2.

PARTS LIST

B1—3-volt battery (two size D cells)
C1—2000-μf., 6-volt electrolytic capacitor
M1, M2, M3—Electric music box movements (Olson Radio X-766—"Around the World in 80 Days"; X-767—"Tea for Two"; X-768—"How Dry I Am")
PL1—Phono plug or other connector (see text)
R1—100-ohm, 1-watt resistor (see text)
R2—350-ohm, 2-watt potentiometer (see text)
S1, S2, S3—S.p.s.t. switch
MIC.—Contact microphone (Argonne AR-18)
1—Two-cell battery holder
1—Wooden cigar box
Misc. terminal strips, rubber feet, knob, hardware

To use the electronic music box, connect *PL1* to the microphone input or "mag. phono" jack of the amplifier. Close one of the motor switches and adjust *R2* for the tempo you want. Gradually increase the amplifier volume until the desired level is reached. Experiment with the amplifier's tone control setting to achieve the most pleasing balance.

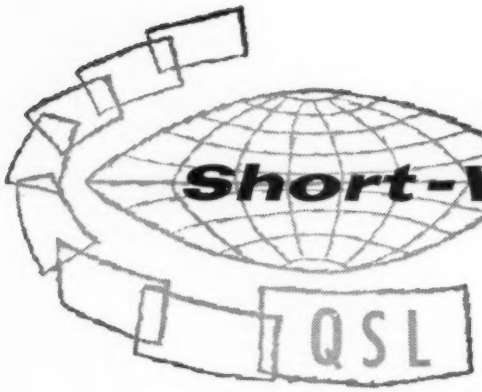
For unusual sound effects, try switching from one music box movement to another while the unit is operating. You can do this by closing one switch and then quickly opening another. With care, a medley of all three tunes can be "played." Other effects may be obtained by adjusting *R2* to slow or speed the tempo. For real fun, try operating *two* of the movements *at the same time*, letting your friends guess the "tune" you are playing. —30—

Electronic Baby-Sitter

Baby-sitting has gone electronic at the ten-million-dollar Beau Rivage Motel in Bal Harbour, Florida, just north of Miami Beach. Fifty rooms in the 300-room motel are wired into a five-camera closed-circuit TV system. A master switchboard permits any five of these rooms to be monitored simultaneously.

When the guests desire the services of a baby-sitter, the pickup from a TV camera directed at the sleeping child is monitored by an attendant in the central control room. If a baby awakes, the attendant sends an assistant to take care of his or her needs. Thus, one "sitter" can watch five youngsters at the same time.

—Harry J. Miller



Short-Wave Report

By HANK BENNETT
W2PNA/WPE2FT

AT THE SUGGESTION of a number of our readers, we are presenting George R. Cox, WPE3JJ, as our Featured DX'er this month. Thirty years old, unmarried, and a commercial artist by trade, he is regarded among DX'ers as one of the most highly skilled short-wave operators in the Eastern United States.

George's proficiency in tuning, coupled with a geographically ideal location (a low coastal area near the mouth of Delaware Bay—he lives at 147 Atlas Drive in the Collins Park sector of New Castle, Del.), is backed up by a well-equipped listening post. His main receiver is a Hammarlund HQ-160, augmented by a 1945 Hallicrafters SX-9. Additional equipment includes a DB-22A preselector and a Meissner calibrator for 10, 50, and 100 kc.

Veteran DX'er George Cox of New Castle, Del., is shown tuning his Hammarlund HQ-160 receiver. His well-equipped setup also includes a Hallicrafters SX-9 receiver, a DB-22A preselector and a Meissner calibrator for 10, 50 and 100 kc.

WPE3JJ's antenna system is not nearly as elaborate as some of our readers may believe, especially after seeing the number and variety of entries in his log book. One of his antennas is a long-wire, 60′ long and 30′ high, and he also uses a vertical antenna. Both are fed with 75-ohm coaxial cable.

As evidenced by his article in the December 1959 issue of POP'tronics, ("DX the Tropics on 60 Meters"), George specializes in tuning the 60- and 90-meter bands—which correspond, roughly, to the frequencies of 3200 and 5100 kc. During the summer months, with their ever-present lightning static, these frequencies are poor at best; however, your Short-Wave Editor can attest to the fact that George's reports during the summer are as filled with exciting catches as they are during the regular DX season.

George began DX'ing in 1947 on the medium-wave bands, and on the short waves in 1948. He sends an occasional report to s.w. stations and to date has 132 veries covering 115 countries. His prize veries are from Novosibirsk, Siberia (5225 kc.) and Spanish Guinea (8800 kc., 400 watts). He particularly likes to tune in the South African Broadcasting Corp. and *Radio Australia* for their fine music.

Some of George's other DX catches include: New Caledonia (3355 kc., 500 watts); CKFX, Vancouver, B. C. (6080 kc., *10* watts); and CR6RW, Cabinda, Angola (5055 kc., 250 watts). In all, he has logged 162 countries.

DX'ers are continually asking how

(*Continued on page* 140)

6 ONE-EVENING ELECTRONIC PROJECTS

PROJECT

1 A First-Project Receiver....68

2 D.C. Control Unit....70

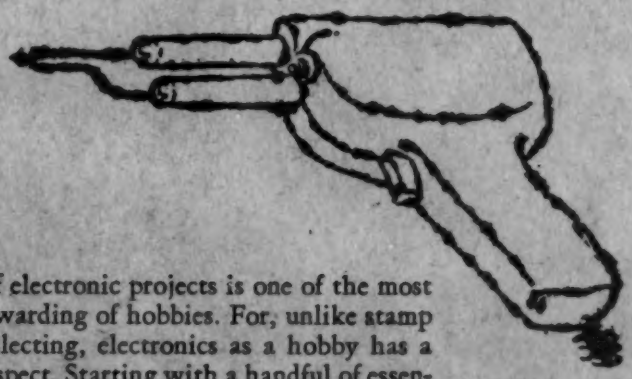
3 Combination Checker....72

4 Hi-Fi Speaker Crossover....74

5 Fuse Saver....76

6 Broadcast-Band Wave Trap....78

• Construction Tips for the Beginner....79



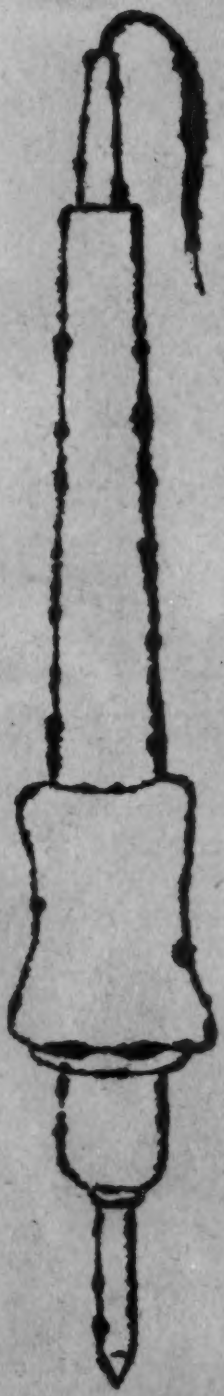
INTRODUCTION

The assembly of electronic projects is one of the most fascinating and rewarding of hobbies. For, unlike stamp or matchbook collecting, electronics as a hobby has a genuine creative aspect. Starting with a handful of essentially "lifeless" components, you can assemble a piece of complex equipment that actually *does something*.

Each new project is a different challenge. And each carries a double-barreled measure of pleasure. First, you'll have fun assembling the project; then you'll enjoy using the completed device. And, above all, each project you assemble carries with it hidden benefits in the form of increased knowledge and skill—valuable assets in this world of increasing scientific complexity.

By LOUIS E. GARNER, Jr.

A First-Project Receiver

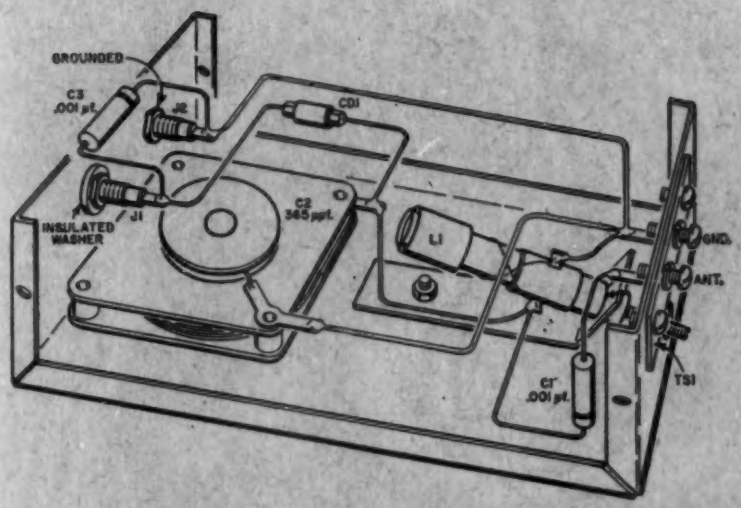


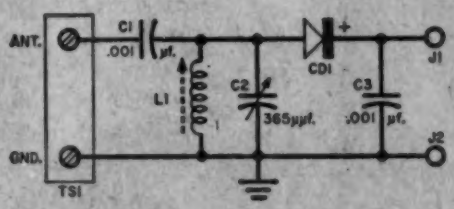
A pocket-sized diode receiver designed around readily available components can be built using the same type of construction techniques employed in tube and transistor receivers. Its assembly is not only a lot of fun, but can serve as a stepping stone to more advanced projects.

Several parts substitutions may be made to save cost. Capacitors *C1* and *C3* are paper, mica, or disc types of from 0.0005 to 0.002 μf. Working voltage is not critical. Any value from 100 volts up is okay. Almost any standard diode may be used such as the 1N34, 1N34A, 1N58, CK705, and so on.

Operation. With the wiring completed and checked, connect a long external antenna (50 to 200 feet) to the *Ant.* terminal. A ground lead may be connected to the *Gnd.* terminal, but is not needed in all areas. A pair of magnetic headphones (500 to 5000 ohms) is plugged into the output tip jacks *(J1, J2)*.

Variable capacitor *C2* is used to tune individual broadcast stations. Experiment with *L1's* adjustment for proper tuning of stations in your area. Generally, *L1* is adjusted *with* the antenna connected so that the highest frequency station in your



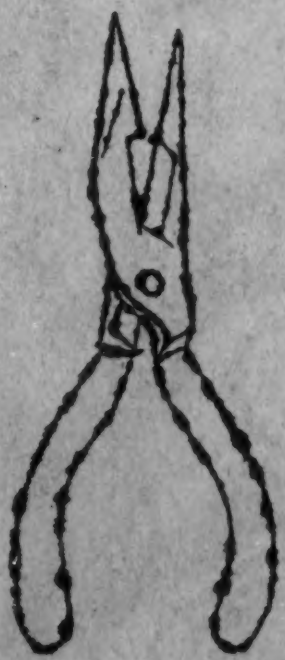


PARTS LIST

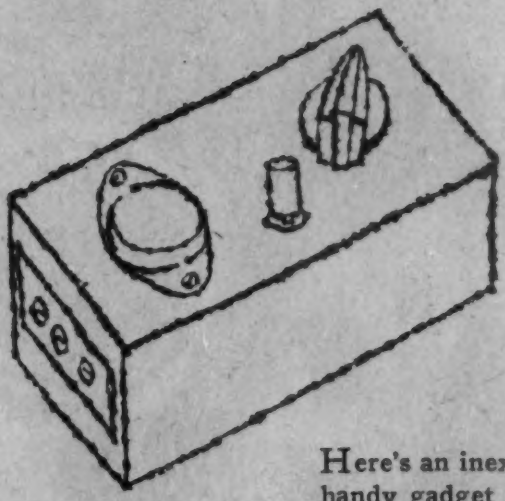
C1, C3—0.001-μf., 100-volt capacitor (see text)
C2—365-μf. flat-type tuning capacitor (Lafayette MS-445 or equivalent)
CD1—Standard crystal diode (1N34, 1N58, etc.)
J1, J2—Insulated phone tip jack
L1—Ferrite loopstick antenna coil
TS1—Two-terminal screw-type terminal strip
1—3¼" x 2⅛" x 1⅝" aluminum box
Misc. control knob, screws, nuts, ground lug, wire, solder, etc.

area falls within the tuning range of capacitor *C2*. Coil *L1's* adjustment, then, compensates for the detuning effect of the antenna lead.

How It Works. In operation, r.f. signals picked up by the antenna-ground system are coupled through *C1* to a tuned circuit made up of *L1* and *C2*. Here, a particular station is selected, with the resulting signal applied to the diode *(CD1)*. The diode, in turn, rectifies the radio-frequency signal. Capacitor *C3* serves to smooth out the r.f. pulses into an audio signal. The current through the earphones varies in step with the modulation of the radio-frequency signal.



D.C. Control Unit

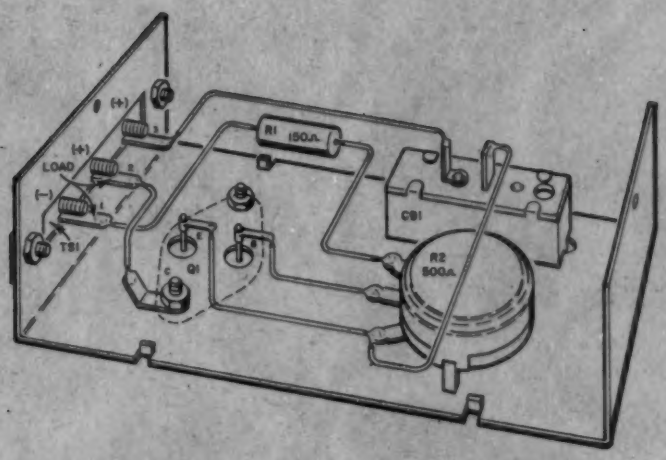


Here's an inexpensive d.c. control that's a mighty handy gadget to have around. If you work with HO gauge trains, you'll find it a valuable throttle control. If model-building is your specialty, you can use it for speed control of small motors and for realistically dimming the lights in model buildings. It's just the ticket for control of plating current in small electroplating jobs. And if microscopy is your field, you'll find it useful for controlling the intensity of substage illuminators.

Construction. Assembled from readily available parts, the unit doesn't cost any more than heavy-duty rheostats—and it's more efficient, handier to use, and provides a smoother control over current. You can put it together in a single evening without being an electronics whiz.

Obtain the parts specified and wire the unit according to the pictorial diagram. Then double-check your work before attempting to use the device.

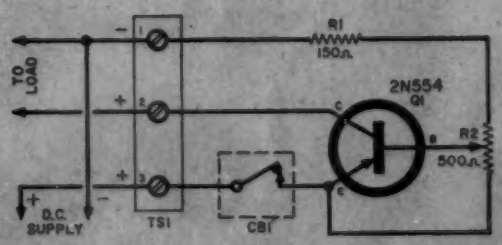
In operation, a standard d.c. power source—such as a HO gauge power pack, storage battery, etc.—is connected to terminals 1 and 3 with the polarity shown, negative lead to terminal 1, positive to ter-



minal 3. If you use a line-operated power pack, you might find it worthwhile to shunt a 1000-μf., 50-volt electrolytic capacitor across the pack's output terminals to remove a.c. ripple. Don't apply more than 16 volts d.c.

Connect your "load" to terminals 1 (negative) and 2 (positive). Then adjust *R2* for the desired current output. Maximum output current is determined by the small 1.35-amp. circuit breaker. If a "short" causes the breaker to trip, find and correct the trouble, and reset by pushing the button.

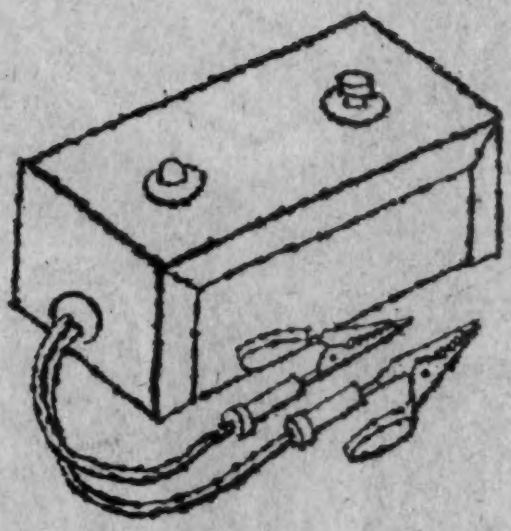
How It Works. A power transistor is used as a series current control. It acts as a variable resistor in series between the power supply and the load. Potentiometer *R2* allows the operator to vary the series resistance effect of the transistor. When the transistor acts as a high resistance, the d.c. output voltage will be low.



PARTS LIST

CB1—Circuit breaker (Littelfuse)
Q1—2N554 power transistor (or 2N307, or 2N256)
R1—150-ohm, 2-watt resistor
R2—500-ohm potentiometer
TS1—Three-terminal screw-type terminal strip
1—4" x2½" x 1⅝" aluminum box
Misc. control knob, soldering lugs, clips, screws, nuts, wire, solder, etc.

Combination Checker



The instrument shown here has more applications than you can shake a stick at. If you're a beginner, you'll find it handy for checking small motors, transformers, speakers, etc., for continuity and shorts. It's also ideal for "in-circuit" tests of selenium and silicon rectifiers.

A small aluminum box serves as the instrument's case. The low-current pilot lamp bulb (*PL1*) used as an indicating device is mounted in a slightly undersized rubber grommet, with connections made by soldering directly to the base; this technique saves the cost of a conventional socket and pilot lamp assembly.

When the wiring is finished, double-check all connections. Look for accidental shorts, broken leads, or cold-soldered joints. Check operation by clipping the *red* and *black* alligator clips together and depressing the push-button switch (*S1*); the lamp bulb should glow brightly.

Testing. To use the instrument, clip one lead to each terminal to be checked (for example, the leads of a small motor) and depress the push button. If the lamp glows, there is a continuity in the circuit; brightness of glow is proportional to circuit resistance. If the lamp doesn't glow, the circuit is open or has very high resistance.

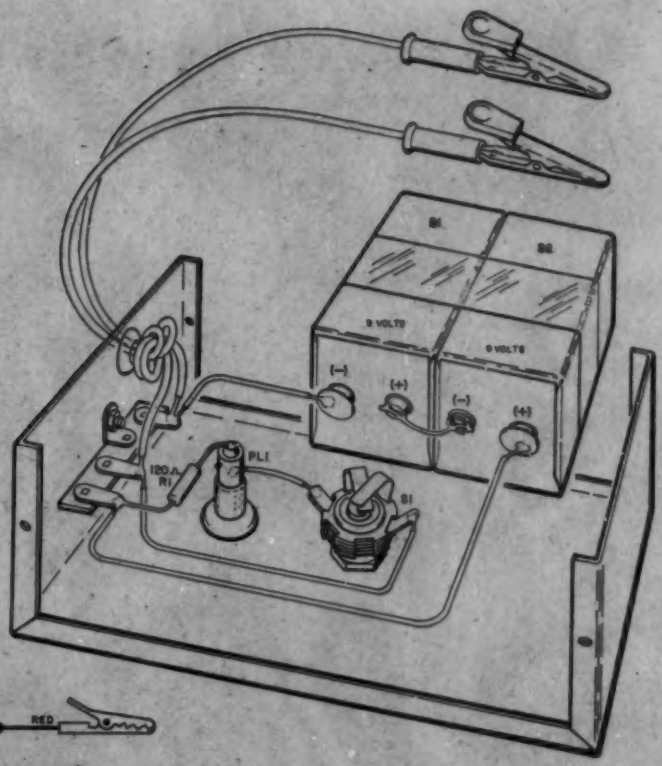
To check a transformer winding for continuity, connect the leads to the appropriate terminals and depress the button. The lamp should glow.

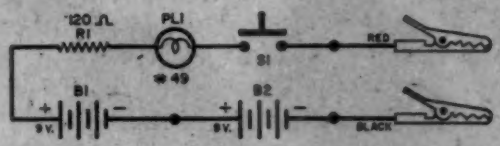
To check loudspeakers or earphones, connect the leads to the component terminals and depress the button. The lamp may not glow, but if the component is "good," a "click" or "thud" will be heard when the button is depressed.

To check silicon or selenium rectifiers, connect the *red* lead to the unit's anode and the *black* lead to the cathode. Then depress the button. If the lamp glows, reverse the leads. Then depress the button again. If the lamp glows, the rectifier is shorted and should

PARTS LIST

B1, B2—9-volt transistor battery (Burgess 2N6)
PL1—Type 49 pilot bulb
R1—120-ohm, ½-watt resistor
S1—S.p.s.t. push-button switch
1—5¼" x 3" x 2⅛" aluminum box
2—Rubber grommets
2—Insulated alligator clips, 1 red, 1 black
1—Pair of battery connector clips to match B1, B2
Misc. tie-point terminal strip; three feet of flexible instrument wire, 18" red, 18" black; screws, nuts, wire, solder



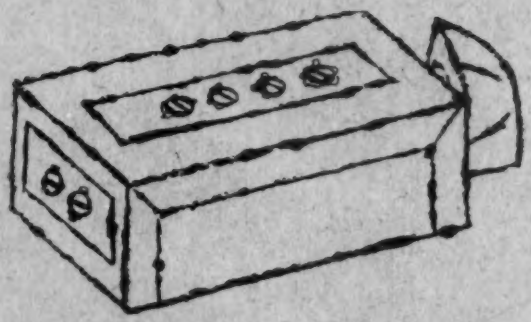


be discarded. If the lamp doesn't glow for *either* test, the rectifier is "open" and should be discarded. If the lamp glows on the first test and remains dark on the second, the rectifier is good. This test may be made with the rectifier in its circuit, provided that power is removed and all filter capacitors are discharged.

How It Works. The instrument is basically a series circuit made up of a power source (batteries), a current-limiting resistor (*R1*), an indicator (pilot lamp), a control switch (*S1*), and the device being checked (connected to clip leads). Circuit continuity is shown by a current flow when *S1* is depressed, lighting the lamp.

Rectifier tests are made by checking the "forward" and "reverse" resistances of the device. Since a relatively high current is used (compared to that applied by a conventional ohmmeter), the test more nearly approximates typical operating conditions and thus provides a more reliable indication of rectifier performance than does a test made with an ohmmeter.

Hi-Fi Speaker Crossover



As a general rule, small loudspeakers do a better job of reproducing high-frequency sounds than do large units. By the same token, a large loudspeaker is best suited to handling low-frequency or "bass" sounds. Professionally designed high-fidelity installations utilize this fact by providing two or more loudspeakers: a small "tweeter" for high frequencies and a large "woofer" for low frequencies, with, often, a medium-sized unit for medium-range frequencies.

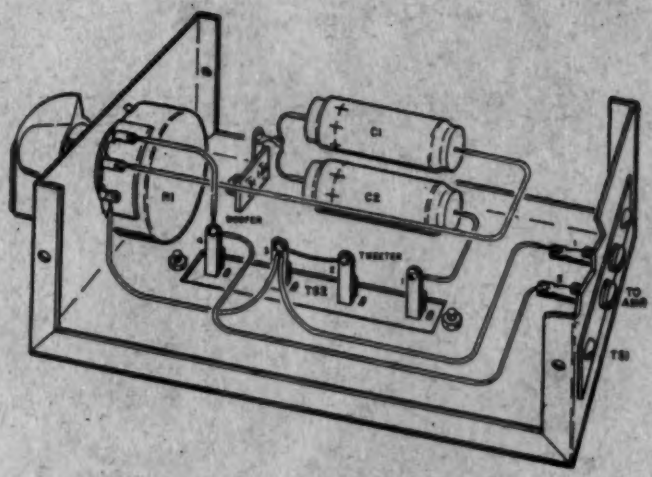
You, too, can take advantage of this fact by adding another loudspeaker to your present radio or phonograph if you do not now have a hi-fi system. All you'll need is another speaker plus a "crossover" to divide the high and low audio frequencies between the two units as shown.

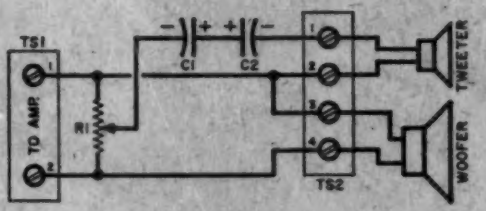
Wire the crossover unit according to the pictorial diagram. Note that the two electrolytic capacitors *(C1, C2)* are connected "back-to-back," i.e., positive terminal to positive terminal. Check the wiring after you have completed it.

Adding a Speaker. If your set now uses a large loudspeaker, one with a diameter of from 8" to 12", you'll want to add a small "tweeter." This can be a 3" to 5" loudspeaker or a commercial tweeter, as offered by most distributors. An 8-ohm unit will work well with any impedance woofer.

If your set now uses a 3"-5" loudspeaker, you'll want to use it as a tweeter and add a "woofer." Obtain a 10" to 12" PM loudspeaker of the best quality you can afford.

Mount the new speaker in a suitable enclosure;





SPKR	3–4 Ω	6–8 Ω	16 Ω
R1	15 Ω	30 Ω	75 Ω
C1, C2	50 µf.	20 µf.	10 µf.

PARTS LIST

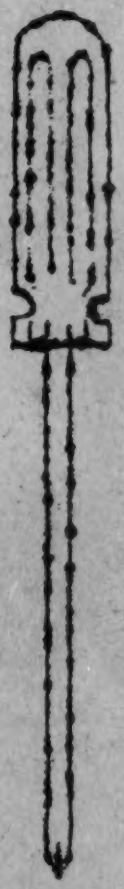
C1, C2—25-volt electrolytic capacitor (see diagram for values)
R1—4-watt wire-wound potentiometer (see diagram for values)
TS1—Two-terminal screw-type terminal strip
TS2—Four-terminal screw-type terminal strip
1—3¼" x 2⅛" x 1⅝" aluminum box
Misc. control knob, screws, nuts, wire, solder, etc.

ask your audio dealer for his recommendations.

Disconnect the leads now connected to the voice coil terminals of your present loudspeaker and connect them to the *Amplifier* terminals of the crossover. Connect your small loudspeaker to the *Tweeter* terminals (1 and 2) and your large speaker to the *Woofer* terminals (3 and 4). Listening to music with a good balance between high and low frequency notes, adjust the crossover's control *(R1)* for the preferred balance between the two loudspeakers.

How It Works. In operation, the two electrolytic capacitors in series form a non-polarized "a.c." capacitor offering a relatively high impedance to low-frequency signals but permitting high-frequency signals to be applied to the tweeter with minimum loss. The 4-watt potentiometer *(R1)* serves as a variable voltage divider, controlling the voltage input to the tweeter.

Fuse Saver



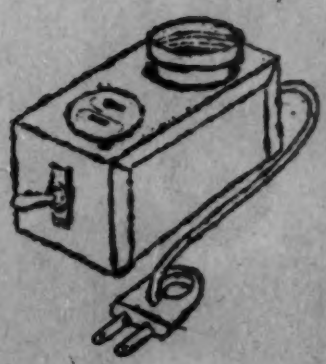
When a beginner tackles his first a.c.-operated project, he may be a little apprehensive about "plugging in" for fear that an error in wiring or a defective component may cause a short circuit—blowing the line fuse, and resulting in a darkened house and much embarrassment.

This easy-to-wire unit can serve not only as a handy "fuse saver" for checking home-built projects, or, later, for tackling service jobs, but also is valuable for keeping a soldering iron warm for ready use without danger of burning out its element through overheating.

All the components are standard and readily available. Total cost will be only around three or four dollars, but you can cut even this considerably by using a small wooden box (such as a cigar box) in place of the finished aluminum case specified and by substituting a cheap slide switch for the comparatively expensive toggle switch.

"Plugging In." With the wiring completed and checked, install a 50-watt lamp bulb in socket *SO1* and plug a radio or phonograph into the "output" receptacle, *SO2*. Insert the unit's line plug into a regular wall outlet. Turn the radio on with *S1* off. The lamp should get warm but not light. Now close switch *S1*. The lamp should start to cool and the radio should play at normal volume.

To use the completed instrument for checking home-built equipment, or for preliminary checks when servicing, install a lamp bulb with a rating approximating the power requirements of the unit tested. Use a 50- to 100-watt bulb for checking small amplifiers, table model receivers, and so on, and a 150- to 200-watt bulb for checking large amplifiers, TV sets, and small transmitters.



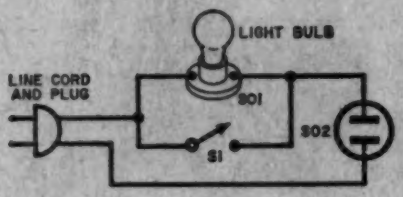
The equipment checked is plugged into *SO2*, *S1* is opened (turned off), and the line plug inserted into the a.c. line. When the equipment is turned on, the bulb should glow, but with less than full brilliance. If the bulb glows with full brightness, there is a short in the equipment which should be cleared up before further tests are made. If the lamp fails to glow, there is an "open" in the equipment's line circuit.

Assuming that the bulb lights to less than full

brightness, *S1* is closed (the lamp will go out) and the equipment can then be operated normally. There may still be a short in the equipment under test (such as a shorted capacitor or tube), but if it does not cause a bright glow in the test lamp, it will not blow a fuse.

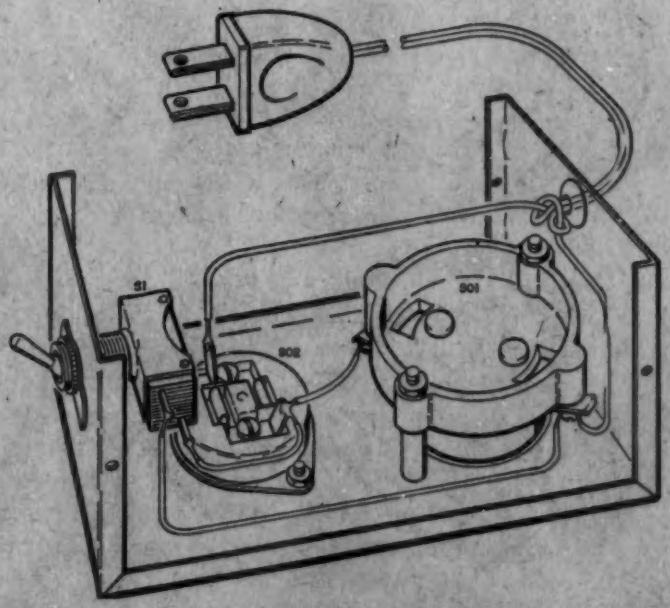
Be careful when you use the instrument. Even with *S1* open, you *could* get a bad shock at *SO2*.

How It Works. In operation, the lamp bulb serves as a series current-limiting resistor with the "load" connected to *SO2*. A "dead short" across *SO2* will light the bulb to full brilliance, but will not blow the line fuse (assuming *S1* is open). The switch, *S1*, serves to short out the bulb, applying full line power to the load, once a preliminary check indicates that everything is normal. When used with a soldering iron, the bulb limits standby current to prevent overheating, but permits the iron to heat up almost instantly when *S1* is closed.



PARTS LIST

S1—S.p.s.t. toggle switch
SO1—Edison-base lamp socket
SO2—Chassis-mount female line receptacle
1—4" x 2¼" x 2¼" aluminum box
1—Line cord and plug
1—Incandescent lamp (see text)
Misc. rubber grommet, spacers, screws, nuts, wire, solder



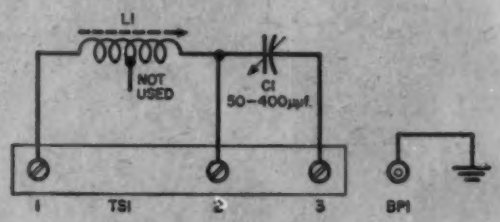
Broadcast-Band Wave Trap

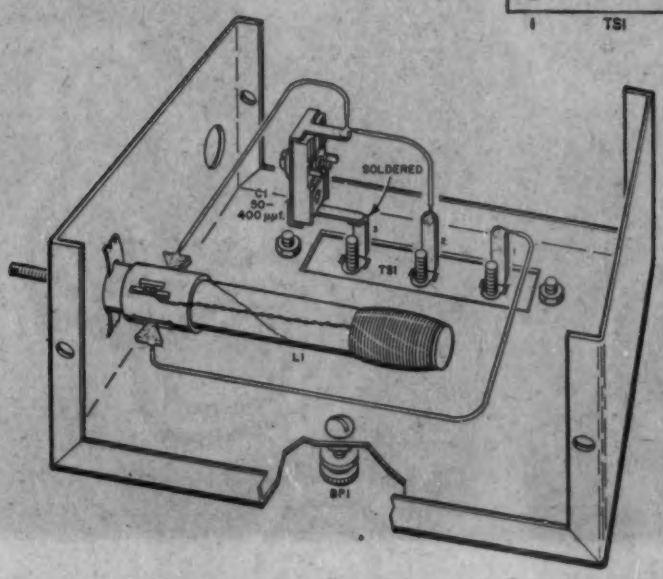
A strong local broadcast station can play havoc with even the most carefully built receivers. Sometimes the strong station will "overload" the receiver, causing distortion and garbled sound, or the station will blanket a good portion of the band. How do you "trap" the radio waves of a strong station? Use a "wave trap."

A suitable model can be assembled from readily available, inexpensive parts in less than an hour's time. Note that padder capacitor *C1* is soldered directly to one of the terminal strip lugs to achieve a strong mechanical support.

With the wiring completed and checked, the universal wave trap can be connected in either of two ways—as a "parallel" or as a "series" trap. Both methods should be tried, with the final installation chosen for maximum effectiveness.

Parallel or Series Connection. To employ the unit as a *parallel* trap, connect terminals 1 and 3 together. Then connect the unit *between* your receiver's antenna lead-in and its antenna terminal. The antenna wire may go to the junction of terminals 1 and 3, for example, with another lead between terminal 2 and the set's antenna post. An external ground lead may be connected to the universal wave trap's case through the terminal provided, but this may not be necessary. To em-





PARTS LIST

BP1—Binding post (uninsulated)
C1—50-400 μμf. (± 20 μμf.) padder capacitor
L1—Variable loopstick ferrite antenna coil
TS1—Three-terminal screw-type terminal strip
1—2¾" x 2⅛" x 1⅝" aluminum box
Misc. screws, nuts, wire, solder

ploy the unit as a *series* trap, remove the lead connecting terminals 1 and 3. Terminal 1 is connected to the radio set's antenna post *along with the regular antenna lead-in.* Terminal 3 is connected to ground or to the set's metal chassis. With either connection, *L1* and *C1* are adjusted for a reduction in the interference of the offending station.

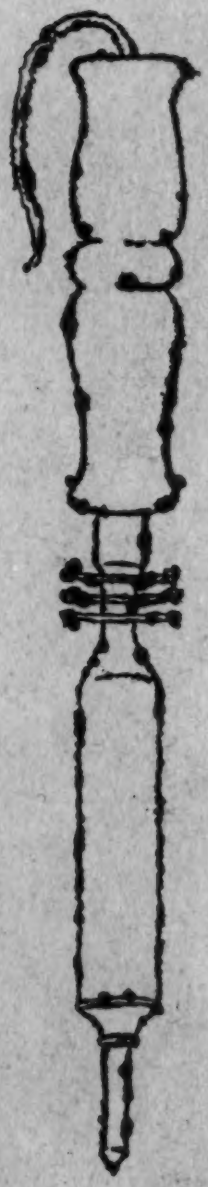
How It Works. Coil *L1* and capacitor *C1* form a simple tuned circuit. Their over-all tuning range is actually broader than that of the AM broadcast band, extending the unit's usefulness into the lower short-wave band. When *L1* and *C1* are connected in *parallel,* the resulting circuit has a high impedance which, connected in series with the antenna, attenuates signals to which the circuit is tuned. When *L1* and *C1* are connected in *series,* the tuned signal is "shorted" to ground.

Construction Tips for the Beginner

Fortunately for those with limited budgets, electronics needn't be an expensive hobby. You can purchase the basic tools you'll need for just a few dollars. Afterwards, you can pick and choose individual projects to fit your interests and your pocketbook. Then, as time goes by, you'll gradually acquire spare parts and components. As your stock increases, you'll find that new projects can be tackled with less and less "out-of-pocket" expense.

If you confine your projects to those using commercially available metal chassis and boxes, you can avoid the need for costly sheet metal cutting and forming tools. You'll find, then, that the typical project is built in three distinct steps, each requiring somewhat different tools: (1) chassis (or case) machining, (2) component mounting, and (3) wiring.

Basic Tools. In the first step, you'll lay out, drill, and punch mounting holes in the metal chassis. For this work, you should have a scribe, a center punch, a hammer, a flat file, a round file, a drill and bits, a tapered reamer, one or more chassis punches, an



adjustable wrench, a small keyhole hacksaw, and, possibly, a half-inch cold chisel.

Don't let the list scare you—it's not as imposing as it seems. A number of substitutions are possible to save cost. If you confine your work to aluminum, for example, you'll find that a sharpened nail can serve as both a scribe and a center punch. While an electric drill is preferred, you can do a good deal of work with an inexpensive hand drill. Or you can substitute a moderate-priced adjustable circle cutter for a set of chassis punches.

After the chassis is machined, the larger components are mounted with small machine screws, lock washers, and nuts. For mounting, you'll need a set of socket wrenches, both regular and Phillips screwdrivers, and a pair of slip-joint pliers.

Finally, for wiring, you'll need a soldering iron or gun, wire strippers, a soldering aid, diagonal cutters, and long-nose pliers. Choose a 30- to 60-watt iron with a small tip or a 100- to 150-watt "gun." The wire strippers are a useful luxury; if your budget is tight, you can use your pocket knife for this work. Get the best-quality diagonal cutters and long-nose pliers you can afford, for these tools are most important.

You should obtain a "starting stock" of small hardware items. This should include #3, #6, and #8 machine screws and hex nuts, #6 and #8 sheet metal screws, lock washers, soldering lugs, a few assorted rubber grommets, *rosin-core* solder, and a hank of #20 or #22 plastic-covered hookup wire.

Buying Components. At the beginning, you'll want to buy electrical components as you need them for individual projects. Later, you may want to build up a small stock of the most popular items to avoid "running short" during construction.

As a general rule, small components other than tubes and transistors are identified with four basic specifications: *value, rating, tolerance,* and *type.* Tubes and transistors are identified by a simple *type number.* Typical tube listings are 6C5, 12AT7, 50L6, 6L6, 6AQ5, and so on; unless the author of the project tells you not to, you can substitute tubes with GT or GTA added to the tube number. Typical transistor types are CK722, GT-229, 2N186, 2N107, 2N170, etc. Diodes and rectifiers, too, are identified by a type number, such as 1N34, CK705, and SD500.

The *value* of a component is specified in electrical units. For resistors, the value is given in *ohms* or *megohms* (millions of ohms). For capacitors, the value is given in *microfarads* (μf.) or *micro-microfarads* (μμf.); the latter unit is one-millionth the value of the former. For coils and chokes, the value is given in *henries* (hy.), *millihenries* (mhy.), and, occasionally, in *microhenries.*

The *rating* of a component indicates its capability. Resistors are rated in *fractions of a watt* (¼ watt or ½ watt) and in *watts* (1, 2, 5, 10, 25, etc.). If the wattage value of a resistor is not given, assume it has a ½-watt rating. Capacitor ratings are in terms of *working voltage* (25 volts, 150 volts, and so on). Coils and chokes are generally rated in terms of *maximum d.c. current,* but may carry a maximum working voltage as well.

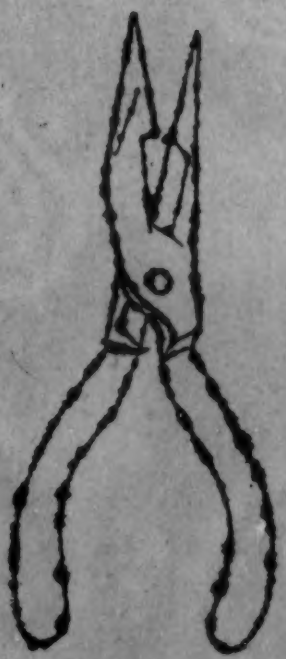
Tolerance indicates the percentage variation of a component from its specified value. Typical tolerances are 1%, 5%, 10%, and 20%. A 100-ohm, 10% resistor, for example, may have an actual value anywhere between 90 and 110 ohms. You needn't worry about parts tolerances unless they are specified in the project's Parts List. You can always use a closer tolerance (5% instead of 10%) than that specified.

A component's *type* is determined by its construction. Resistors may be composition or wirewound types. Capacitors may be paper, ceramic, mica, or electrolytic units. Coils and chokes may be air-core, ferrite-core, or iron-core units.

While all four specifications are important, the most critical is the component's *value.* In general, the *rating* specified indicates the *minimum* permissible; if physical space permits, a higher-rated unit may be substituted, but not vice-versa. Thus, a 1-watt resistor may be used in place of a ½-watt unit, or a 2-watt resistor in place of a 1-watt unit. Higher-voltage paper or ceramic capacitors may be substituted for lower-voltage types, but avoid using electrolytics with more than twice the required voltage. Electrolytic types require a large percentage of their operating voltage in order to charge themselves to their full rated capacity.

Construction Hints. Here are a few tips from an old-timer at assembling electronic projects:

Keep your soldering iron tip very clean at all times. Make sure the tip is good and hot before



using. Apply the iron *and* solder the joint simultaneously.

Double-check your work as it progresses. It's easier to correct a wiring error *before* the job is finished.

Watch out for accidental short or open circuits. Use insulating spaghetti tubing to protect bare leads.

Observe the polarities of electrolytic capacitors, batteries, diodes, transistors, and similar "polarized" components.

When you are soldering a transistor or diode lead, grasp the lead with a pair of long-nose pliers *between* the soldered point and the component's body. This will conduct the heat away and avoid damage to the component.

Don't apply power to a completed project until you've rechecked all connections.

Finally, use your tools only for the job for which they are designed. *Never* use a screwdriver as a chisel or pry-bar, nor a pair of long-nose pliers as a substitute for a wrench.

Using Pictorials. If a pictorial accompanies the schematic diagram (as in the preceding projects), you should be aware of certain facts in connection with it.

For the sake of clarity, component leads are usually shown longer than actually necessary. The leads should be cut so that they are no longer than required for convenient mounting.

Tie posts, ground lugs and terminal boards are usually *not* shown on the schematic although they are present in the pictorial of the actual unit. Their purpose is to provide common circuit junction points for the components, enable a neat layout, and provide supports for components which would otherwise tend to "dangle" from their leads. Since tie posts are available in a variety of types, make sure that you use the ones with ground lugs in the correct position for your circuit.

When you arrange the components in a small aluminum box, make certain that the cover will fit in place after the parts are mounted. This should be done *before* you drill any mounting holes or solder any connections.

Good luck . . . and have fun!

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Portable Utility Amplifier

Battery-powered transistorized amplifier has many useful workbench applications

By
LUIS VICENS

WHETHER your interest in electronics lies in servicing, in project construction, in circuit experimentation and testing, or in a combination of all of these, you'll find that a self-contained audio amplifier is one of the most valuable instruments you can add to your home workshop. Here is a unit you can have fun building, and then use to trouble-shoot or debug other projects.

For maximum utility, this audio amplifier was designed to deliver from 500 to 750 milliwatts with a frequency response and distortion level adequate for checking high-fidelity components. Both high and low input impedances are available, with a variety of input jacks for versatility. Overall gain is high enough to permit its use with a magnetic phono cartridge, and battery operation minimizes hum and reduces the possibility of ground loops in checking other equipment.

Easy to build, using readily available components and

There's no need to plug in this transistorized unit. Just connect your source of audio, switch it on, and you have an amplified output—instantly.

standard hand tools, this unit compares favorably with high-quality factory-built equipment in both appearance and performance. The circuit consists of a three-stage amplifier using *p-n-p* transistors. Resistance-capacity coupling is used in the first two stages, with the second stage transformer-coupled to a class AB push-pull power amplifier.

Construction. You can build the three-stage transistorized amplifier on a 3½"-square etched-circuit board (or use conventional wiring, if you wish). A wall baffle for an 8" loudspeaker provides the amplifier housing. The chassis is bracket-mounted on the rear fiberboard panel of the baffle with leads to the speaker of sufficient length to permit testing and repair. The mounting technique is shown at right.

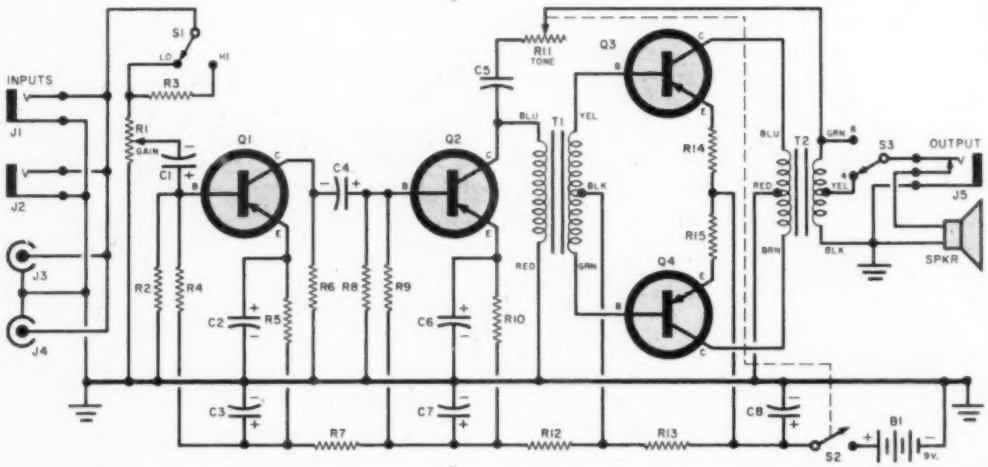
Before final assembly, install the transistors, connect the battery and give the instrument an over-all operational test by applying a test signal to one of the input jacks. Use an audio oscillator, radio tuner, record player, or even a small crystal receiver for the test. Turn the unit "on" by rotating the *Tone* control, and listen to the speaker's output. Adjust the *Gain* and *Tone* controls throughout their ranges to check them.

Operation. To test a phono cartridge or microphone, connect it to any of the four

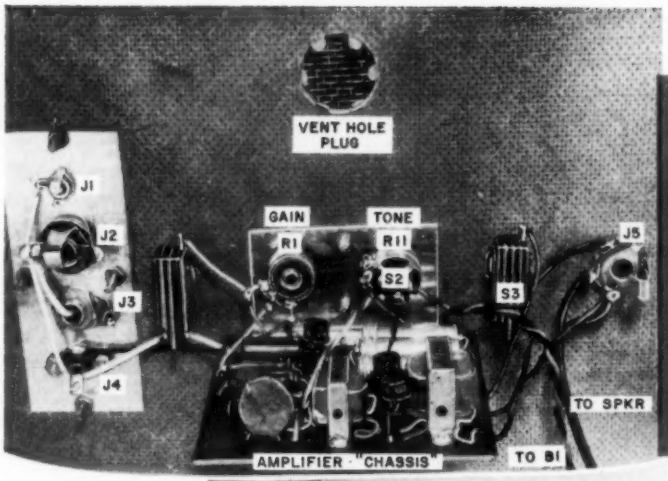
(*Continued on page* 123)

PARTS LIST

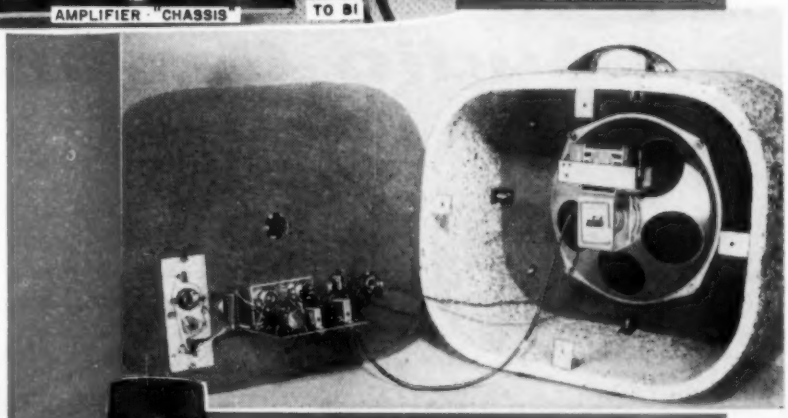
B1—9-volt battery (Burgess 2N6 or equivalent)
C1, C4—30-μf., 6-volt electrolytic capacitor
C2, C6—30-μf., 15-volt electrolytic capacitor
C3, C7, C8—50-μf., 12-volt electrolytic capacitor
C5—.02-μf., 50-volt capacitor
J1—Miniature open-circuit phone jack
J2—Open-circuit phone jack
J3—Panel-mounting coaxial microphone connector
J4—RCA-type phono jack
J5—Closed-circuit phone jack
Q1, Q2—2N323 transistor
Q3, Q4—2N321 transistor
R1—5000-ohm potentiometer (audio taper)
R2—150,000 ohms
R3—470,000 ohms
R4—10,000 ohms
R5, R7, R10—1000 ohms
R6, R9—4700 ohms
R8—47,000 ohms
All resistors ½ watt composition unless otherwise indicated
R11—25,000-ohm potentiometer (linear taper) with s.p.s.t. switch (S2) mounted on rear
R12—220 ohms
R13—47 ohms
R14, R15—10 ohms
S1, S3—S.p.d.t. toggle switch
S2—S.p.s.t. switch on R11
T1—Driver transformer; 10,000-ohm primary; 2000-ohm center-tapped secondary (Argonne AR-109 or equivalent)
T2—Output transformer; 160-ohm center-tapped primary; 3.2- 8-ohm secondary (Argonne AR-170 or equivalent)
SPKR—8" PM loudspeaker, 3.2- 8-ohm voice coil
1—Loudspeaker wall baffle (Lafayette SB-56 or equivalent)
1—3½" x 3½" etched circuit board (see text)
Misc. fiberboard, hardware, transistor sockets, brackets, etc.

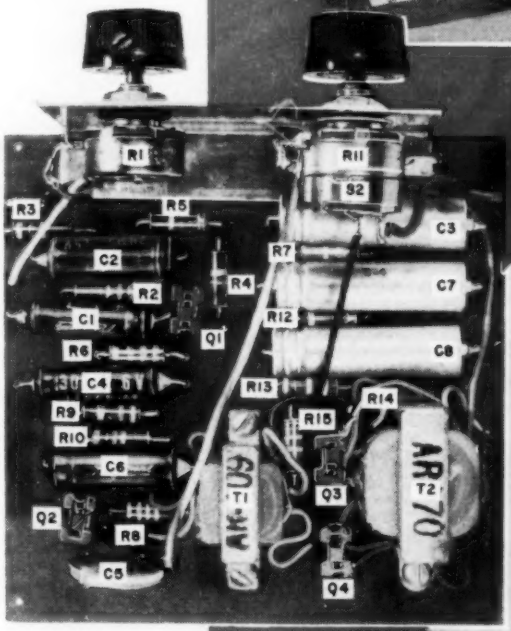


Four input jacks are provided in the utility amplifier for versatility. Low and high input impedances can be selected by switch S1 and both 4- and 8-ohm outputs are available for the self-contained speaker or at output jack J5.

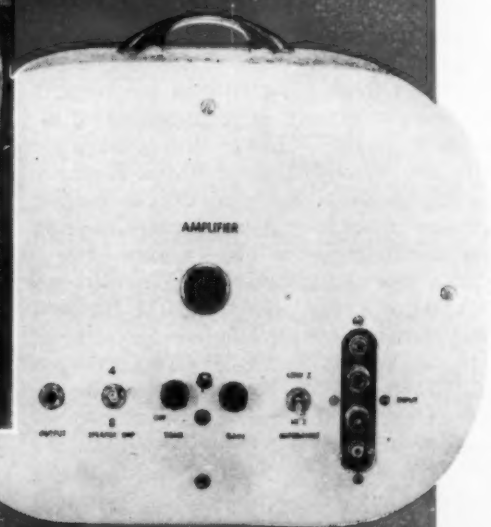


Mount amplifier chassis, controls, input and output jacks on rear panel of speaker baffle. Allow sufficient lead length between speaker, battery, and rear panel so that the unit can be opened for test and repair.





Compact chassis is achieved by using printed-circuit board. Similar layout can be made on perforated phenolic board.



Test Instruments

the Audio Generator

By LARRY KLEIN

Part 3 Clippers, Cathode Followers, and Metering

IF YOU were shopping around for an audio generator, you would find that there were many choices available. A comparison of the various models manufactured by about a dozen companies would reveal a number of very interesting features.

Some generators, for example, provide a choice of switched high- or low-impedance outputs. Others have built-in metering, a square-wave output, or a db-calibrated attenuator switch. You'll find generators with any combination of these features. The big question is—what do the various facilities mean to you in terms of making your testing easier or more accurate?

Let's take another look at a generator we covered previously—the EICO 377. Its front panel controls include a four-range selector or "band" switch (20-200, 200-2000, 2000-20,000, 20,000-200,000 cycles) and an output level or amplitude control. And there's an on-off switch and a frequency selector, of course. But what makes this unit different from most other generators is a slide switch labeled *Waveform*. The circuitry associated with this switch provides either sine-wave or square-wave output over most of the audio range.

Squaring the Wave. The block diagram of the EICO audio generator shown in Fig. 11 includes a "clipper" circuit which can be switched in or out at the option of the user. Schematically, the circuit appears as in Fig. 12. A little analysis may be in order.

The first triode of the 6SN7 consists of an unbiased amplifier which clips the positive peaks of the signal when the tube is driven to the point at which the grid begins to draw current. Since the negative alternation of the incoming sine wave is of sufficient amplitude to drive the tube past cutoff, the negative portion of the wave is also clipped when it appears at the plate.

In addition, the positive peak is further squared off. The second triode of the 6SN7 (also biased to a nonlinear portion of its operating curve) carries the squaring-off process to completion by more amplification and clipping. When the sine-square waveform switch (S1*a*,*b*) is set to sine position, the 6SN7 tube circuit is bypassed entirely.

Signal Output. The cathode-follower circuits found at the outputs of most audio

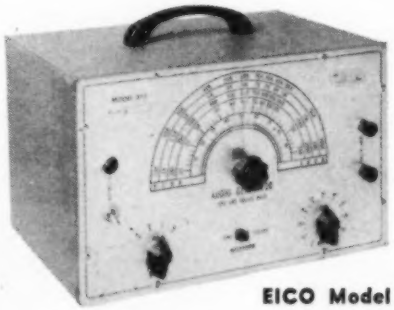
generators differ only slightly from those encountered in high-fidelity applications. This is logical, since the purposes served are similar.

In general, a cathode follower acts as a matching transformer. Its high input impedance has a minimum loading effect on the preceding circuit, and its low output impedance makes its frequency response and output voltage relatively independent of the load.

The cathode follower shown in Fig. 13, for example, delivers an output reaching 14 volts when the external load across the generator's terminals is 10,000 ohms or higher. If the load is as low as 1000 ohms, a 10-volt output is still available. And, in fact, it's even possible to connect a 16-ohm loudspeaker directly across the output terminals of the EICO generator and get sufficient output to run a speaker impedance curve. The frequency response of the cathode follower is relatively independent of the resistance and capacitance of the load connected across it.

Attenuation Problems. A large output voltage from the generator is handy to have, but what happens when we want a low-voltage output, let's say, in the 5-50 millivolt (.005-.05 volt) range? Unfortunately, just setting the output potentiometer on the generator toward the bottom end of its range won't do the job properly—for two reasons. First, the output control is usually installed in the circuit *before* the cathode follower and therefore the normal noise generated in the cathode-follower stage is not attenuated by the control when the signal voltage is reduced. This means that the hum and thermal noise (which is normally swamped out by the high signal voltage) now becomes a significant percentage of the output signal and the signal-to-noise ratio of the generator suffers.

The second reason why the output potentiometer alone isn't adequate can be blamed



EICO Model 377

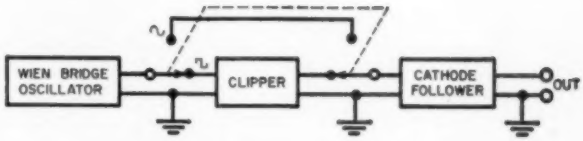
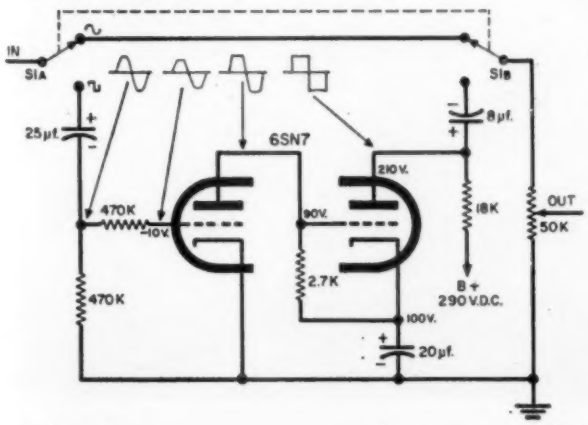


Fig. 11. The EICO Model 377 audio generator includes clipper circuit which can be switched out. Clipper "squares" sine-wave output of Wien bridge oscillator.

Fig. 12. Schematic of the clipper portion of the EICO circuit shows how the sine-wave output of the oscillator is gradually shaped into a square wave.



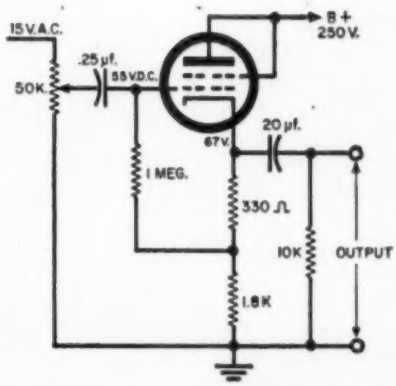


Fig. 13. Cathode-follower in EICO circuit transforms high-impedance outputs of oscillator or clipper into low impedance at output terminals of generator.

Knight-Kit 83YX137

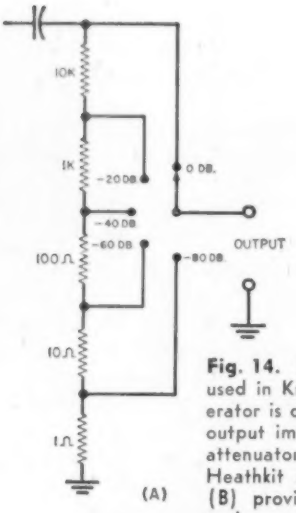
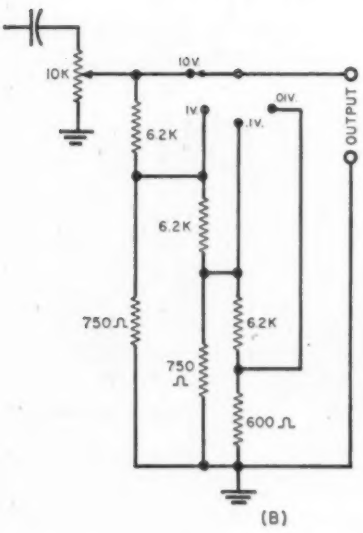


Fig. 14. Simple attenuator circuit (A) used in Knight-Kit 83YX137 audio generator is calibrated in db with different output impedances in each position of attenuator switch. Ladder attenuator in Heathkit AG-10 sine-square generator (B) provides constant (600-ohm) impedance output on three lower ranges. Switch positions are calibrated in volts.



Heathkit AG-9A

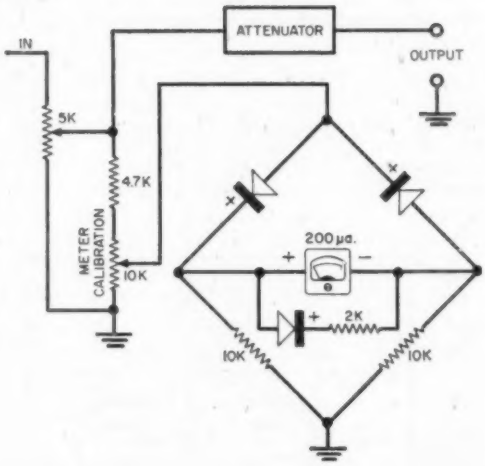


Fig. 15. The metering circuit incorporated in the Heathkit AG-9A indicates signal level at the attenuator. The diode across the meter compensates for nonlinearity of bridge diodes at low signal levels.

on the mechanics of the situation. It's generally known that pots become "touchy" if you try to adjust them too finely down at their bottom end (fully counterclockwise position). This problem is complicated by the fact that a fraction of a degree of rotation of the pot can easily make a difference of 100 mv., which is not surprising when you consider that in the circuit of Fig. 13 there is about 15 volts of signal applied across the pot. The pot would have to be set to only 1/1000 of its rotation to achieve a 15-millivolt output.

Switched Db's. A number of generator manufacturers solve this problem neatly and add a useful function besides by installing a stepped attenuator circuit in place of the fixed 10,000-ohm resistor of Fig. 13. The attenuator circuit used in the Knight-Kit

(*Continued on page* 124)

By **BILL WALKER,** K2RUK

Understanding Ham Lingo

"YOU tie the ribbons on it, Mike. I'm going to modulate the pillow. 73. This is K2RUK, the Rough Ugly Kid, listening for your final before pulling the big switch. K2RUK is off and clear."

When I signed off this way on a recent evening after an interesting chat with a fellow ham a thousand miles away, he knew that I had said, in effect: *"You make the final remarks, Mike. After you're finished, I'll turn off my receiver and go to bed."*

The regulations of the Federal Communications Commission state that phonetics may be used in radiotelephone transmission, and there are one or two recommended lists of phonetics. (See accompanying ARRL list). But hams are usually people with more than average imagination. So don't be surprised when radio amateurs use such expressions as "Good Looking American," "Tiny Pink Elephants," "Empty Beer Mugs," "Old King Solomon," "Custer's Wild Indians," and "Dirty Rotten Apples."

All of these expressions with the first letters matching the ham's license can be heard any day on the amateur wavelengths. One ham, whose last three letters are NYT, lists himself as the "New York Times" station in the Radio Amateur Call Book. Other names in the call book are "Pretty Red Rose," "Heavy Set Friend," and "Radio Norte America."

After first considering "Red Under Kilts" and "Romeo Under Khaki," *I* decided on "Rough Ugly Kid" for my own call.

In the everyday parlance of the ham brotherhood (and sisterhood), earphones are "cans." A receiver may be a "listening box," "hearing aid," or "inhaler." A transmitter is always "the rig." And an amateur's antenna "goes up the chimney."

Many a short-wave receiver has an S-meter which is used to read the signal strength of an incoming signal in decibels. Decibels are usually called "db's," and occasionally "dog biscuits."

Radio amateurs the world over say goodbye with the expression "73," whether they use Morse code or not. A YL operator (young lady) will say "88," signifying love and kisses. An XYL is, of course, a former young lady, or a wife—who also can be expected to transmit "88." (If my wife ever finds out how many girl friends all over the world have said "88" to me—boy!)

(*Continued on page* 136)

PHONETIC ALPHABET

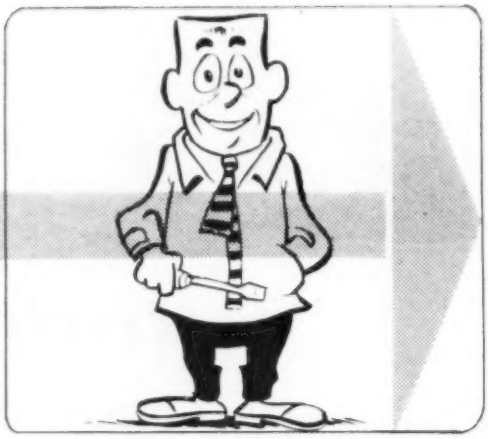
A—Adam	N—Nancy
B—Baker	O—Otto
C—Charlie	P—Peter
D—David	Q—Queen
E—Edward	R—Robert
F—Frank	S—Susan
G—George	T—Thomas
H—Henry	U—Union
I—Ida	V—Victor
J—John	W—William
K—King	X—X-ray
L—Lewis	Y—Young
M—Mary	Z—Zebra

Example: W1EH . . . W 1 Edward Henry

The phonetic list as recommended by the American Radio Relay League (right) is most often heard on the ham bands. However, many amateurs use every possible combination between "Aardvark" and "Zygote."

The Short-Circuited Enthusiast

By CARL KOHLER
and JIM WILLIAMS



I'm an electronics enthusiast.

. . . surrounded myself with schematics

. . . and settled down to do big things.

Neighbors had their troubles, too.

Even strangers brought problems.

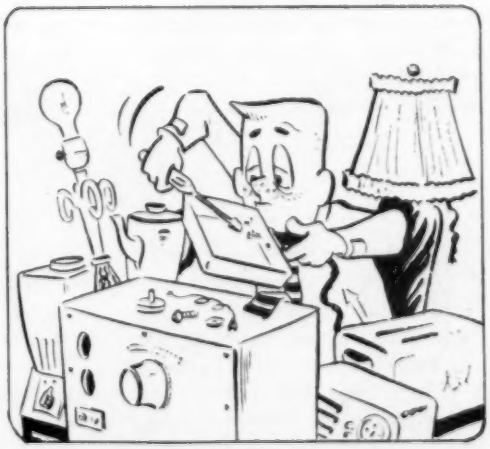
I selected a quiet corner

. . . stocked it with components

But my wife brought her iron.

Friends brought their appliances.

I'm still an electronics enthusiast

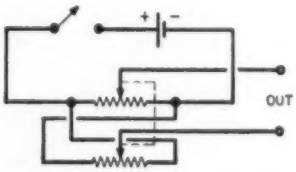


. . . hoping to do big things, some day.

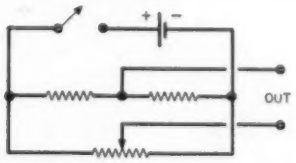
Unusual Uses of Potentiometers

Potentiometers are effective not only as voltage dividers, but they can be used to shift polarity of a power source as well. These potentiometer hookups are useful in power, audio, or r.f. experiments and home-brew projects. Save the schematics for future reference.

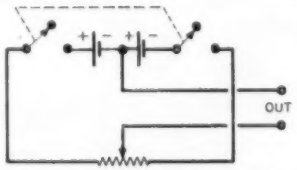
By KENNETH RICHARDSON



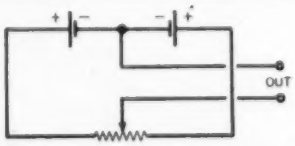
1 Two similar ganged potentiometers can be cross-connected across a battery or power supply to give any positive or negative voltage between zero and the supply voltage. The circuit is a Wheatstone bridge with a null (zero output) obtained when the pots are in center position. Voltage output is maximum when the arms of the pots are in their end positions. The polarity of the output voltage is opposite on either side of the potentiometers' center position. In selecting the potentiometers, be sure to choose units which have sufficiently high wattage ratings to avoid their being burned out by excessive current drain.



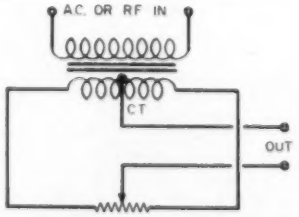
2 Here is another voltage-control bridge circuit but this one uses only a single potentiometer. The two identical fixed resistors which make up the other side of the bridge should total the resistance of the potentiometer. Either positive or negative voltages can be tapped off, but only up to a maximum voltage of one-half the power supply voltage.



3 Variation of the basic voltage-control circuit employs a center-tapped battery instead of fixed resistors. Otherwise, operation is similar to Circuit 2. A d.p.s.t. switch disconnects the batteries when the circuit is not in use.



4 No switch is required when batteries of equal voltage are connected back-to-back since the potentiometer does not drain any current. Operation is similar to Circuit 2 except that the voltage output varies somewhat with different load resistances. Hence, it is impossible to calibrate the dial of the pot accurately.



5 Here, a power, audio, or r.f. transformer is used instead of a pair of batteries in series. The a.c. or r.f. output can be adjusted by the pot to any desired voltage, and its phase can be reversed by setting the pot to either side of center. This circuit can be used to obtain Lissajous patterns on oscilloscopes.

Transistor Topics

The circuit of this completely transistorized Knight KN-3225 25-watt mobile p.a. amplifier is discussed in the text.

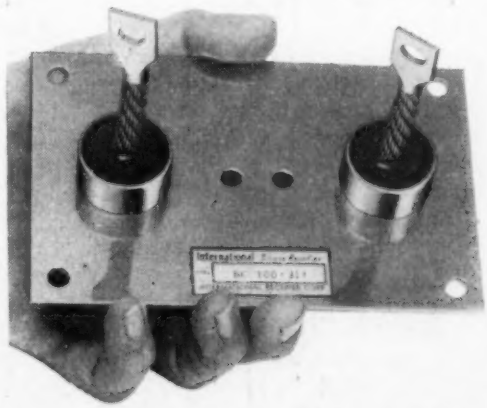
By LOU GARNER

DURING the past year or so an unpublicized—but far from quiet—revolution has been taking place in the design and manufacture of mobile public address amplifiers. Nearly all manufacturers are in the process of replacing all-tube designs with fully transistorized models. Unlike the situation in the car radio field, there has been no evolutionary step. No "hybrid" (part tube, part transistor) p.a. amplifiers have been offered. The switch to transistor operation is being done directly.

The Knight Model KN-3225 amplifier typifies modern design practice. Manufactured and distributed by Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill., this unit measures only 3½" x 10¾" x 6" over-all and weighs about 10 pounds. With a rated power output of 25 watts, it has an over-all frequency response flat within 3 db from 100 to 10,000 cps. Its power consumption ranges from 3.4 to 50 watts, depending on output level. In terms of battery current, this is from slightly over a quarter ampere (or less than a car's parking lights) to somewhat under 4 amperes (at 13 volts), compared to the 8 to 12 amperes required by a tube-operated amplifier with similar capabilities. The unit can deliver as much as 18 watts when powered by an 11-volt source.

The Model KN-3225 is equipped with all the basic features needed for good p.a. operation. It is designed to use a low-impedance microphone, standard for professional p.a. work, and provision is made for adding a battery-operated record player or "phono top." An output impedance selector makes it easy for the operator to match various loudspeaker combinations. The unit may be powered either by a vehicle's electrical system (through a car lighter plug and power cable) or by a pair of heavy-duty 6-volt batteries.

Circuitwise, the instrument includes a two-stage resistance-coupled preamplifier, a two-stage direct-coupled driver, and a class AB push-pull power output stage. All transistors are *p-n-p* units, with power



Low-cost silicon rectifier assembly designed by International Rectifier for battery charger applications. See page 126.

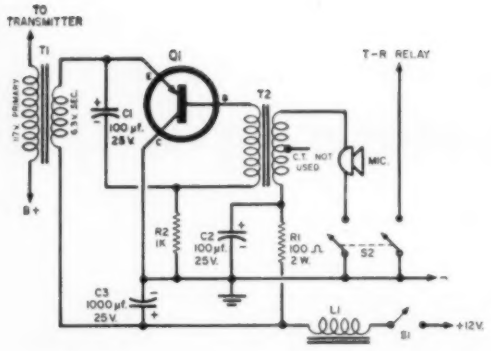


Fig. 1. Two-watt modulator for low-power applications submitted by Charles Hartley. For mobile use, either the negative or positive terminal of the unit should be grounded, depending on make of the car.

transistors used in the driver and output stages and low-power units in all other stages. Inverse feedback is used around the driver and power output stages to insure stable operation and low distortion. Stabilized d.c. biasing permits satisfactory operation of the amplifier from −10° to +130°F.

A rectifier has been incorporated in the power line even though the amplifier is designed for battery operation only. The rectifier will protect circuit components in the event battery polarity is reversed accidentally during installation. The unit will not work, but no damage will result.

Finally, the battery circuit is completely isolated from chassis and case ground, preventing accidental shorts through the microphone shield, output cables, case, or mounting brackets (if used).

Readers' Circuits. This month we are featuring a pair of circuits which should be especially appealing to hams, and to experimenters working with Citizens Band gear, small transmitters, and similar equipment. Although quite versatile, both are fairly simple and easy to duplicate using standard, readily available components.

Figure 1 shows a two-watt modulator for low-power transmitters. Charles Hartley (909 Grant St., Medford, Ore.), who submitted this circuit, uses it to modulate a 10-meter mobile transmitter.

A single *p-n-p* power transistor, *Q1*, is used as a transformer-coupled amplifier. A carbon microphone (*MIC.*) furnishes ample drive through input matching transformer *T2* (Thordarson 21F27 transformer, 117-volt primary to 26.5-volt CT secondary). *T2*'s center tap is not connected. Microphone current is supplied through current-limiting resistor *R1*, bypassed by *C2*, and through one section of the d.p.s.t transmit switch *S2*, a standard push-button assembly; *S2*'s second section is used to control the rig's transmit-receive (*T-R*) relay.

In operation, *Q1*'s base bias is furnished through *R2*, with the amplified audio signal coupled to the transmitter by modulation transformer *T1* (any 6.3-volt, 0.6-ampere filament transformer). Coil *L1* and capacitor *C3* form a simple "hash" filter; *L1* is a standard "hash" choke, but a surplus ARC-5 choke can be used here if you wish.

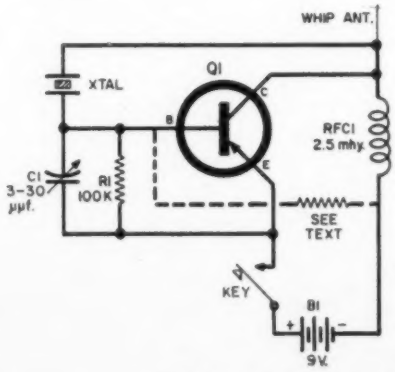
Neither circuit layout nor lead dress should be especially critical. The entire modulator may be assembled on a small metal chassis or in one of the popular Miniboxes. Any of a number of power transistors can be used, such as the Sylvania 2N242, Delco 2N442, Philco 2N353, and RCA 2N301.

In assembling the modulator, make sure that the transistor's case (connected internally to its collector) is securely mounted to the metal chassis to insure best heat dissipation. Some experimentation may be needed to determine the optimum value for bias resistor *R2* and microphone current resistor *R1*. Try values on either side of those specified, installing the units which give best operation.

Bill Darling, WV6ICY (960 Granvia, Altamira, Palos Verdes Est., Calif.), submitted the circuit shown in Fig. 2. This is essentially a low-power r.f. transmitter which, according to Bill, is extremely use-

(*Continued on page* 125)

Fig. 2. Bill Darling, WV6ICY, uses this low-power r.f. transmitter at hamfests.



Across the Ham Bands

By
HERB S. BRIER
W9EGQ

NOISE IN R.F. AMPLIFIER TUBES

RECEIVER DESIGNERS are faced with the dilemma of designing a receiver that will perform well on all bands, and, therefore, the necessity of using an r.f. amplifier tube that will give the best general coverage. But most tubes that show high gain and stability as r.f. amplifiers on the lower frequencies (80 and 40 meters) often are noisy on the high frequencies (10, 15 and 20 meters).

If you work the higher bands frequently, you might do well to follow the advice of Pete, K4VNK. He says that replacing the 6SG7 in the r.f. stage of receivers like the Hallicrafters S-85 and SX-99 with a 6AC7 tube will really pep them up.

Pete is right. The 6AC7 is an old friend of mine. It has a transconductance of 9000 μmhos compared to 4700 μmhos for the 6SG7. But, more important, the 6AC7 has a noise figure less than one-quarter as high as the 6SG7. Substituting it for a 6SG7 as the first tube in a receiver should improve the receiver gain and signal-to-noise ratio, especially on the higher frequency bands. Although the 6AC7's extra gain is sometimes helpful, its lower noise is what really makes the difference.

When it comes to noise, tubes are like "noiseless" typewriters. They are not supposed to have any noise, but they all do. Other things being equal, the quieter the tube, the better the results, especially in the first r.f. stage of a ham receiver, because DX signals are often very weak.

Design Problems. The natural question is: if changing a tube in a receiver will improve its performance, why didn't the re-

Ham of the Month

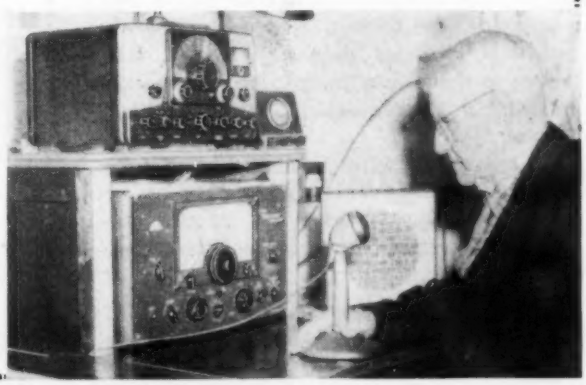
Our Ham of the Month for March is Fred E. Bath, VE1LG, Middleton, Nova Scotia, Canada. Born September 2, 1875, today he is 84, Canada's oldest ham. Fred became interested in radio years before loudspeakers and a.c. receivers were invented. But it was not until early in 1937, when illness put him in bed for several weeks, that he found time to study for his license. He has been an active ham ever since.

Fred rates working his first ZL (New Zealand) with his first low-power transmitter as his biggest thrill as a ham. He has provided emergency communications with his ham rig when hurricanes and blizzards disrupted normal channels. He generally uses phone now and prefers rag-chewing to involved technical talk.

When VE1LG is not on the air, and Fred is not occupied in his profession as a Wholesale and Retail Commission Merchant, he is apt to be in his yard erecting an antenna or in his shop working on a new one. His present favorite is a rotary, 10-meter cubical quad.

For some time transmitter power at VE1LG was 300 watts. But for the past two years, Fred has been happy with 65 watts to his Johnson Ranger. He receives with a British Commander, a dual-conversion receiver for the ham bands only.

Look for Fred on 10-meter phone during his lunch hour or after 4:00 p.m. AST.



Rodger Skinner, KN3JMP, Monaca, Pa.

ceiver manufacturer use a better tube in the first place? There is no single answer to that question. However, as indicated above, one reason is that a receiver is expected to receive weak signals satisfactorily but not overload on extremely strong signals. And the difference in the strength between the two extremes is often over a million to one!

To handle this tremendous range of signal strengths, the receiver designer employs variable-μ tubes—such as the 6SG7 and the 6BA6—as r.f. and i.f. amplifiers, and actually controls their amplification factor or μ with the receiver sensitivity control and a.v.c. circuit. Unfortunately, because of their construction, such tubes have a slightly higher noise figure than tubes without this feature. Therefore, by using them, especially as a first tube in a receiver, the designer sacrifices a trifle in weak-signal performance in exchange for better over-all performance.

On the other hand, if we replace the original variable-μ tube in the r.f. stage of our receiver with a quieter, fixed-μ or "sharp-cutoff" tube, we can often improve its ability to receive extremely weak signals on the ham bands above 14 mc. Below that frequency, the noise picked up by the antenna is stronger than any normal tube noise; so there is nothing to be gained from having an extra-quiet r.f. stage on these frequencies.

In any event, with the sharp-cutoff tube, the receiver will probably overload on extremely strong signals. If you are surrounded by local hams, this will be a serious disadvantage, but if there are no other hams in your immediate neighborhood, it may be of no importance to you.

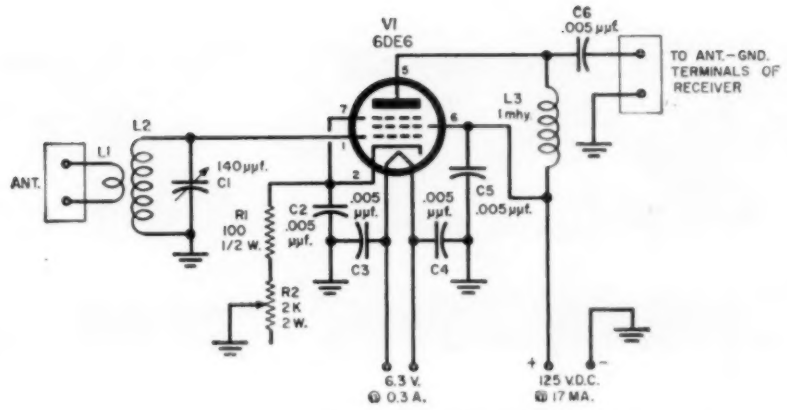
Better S-Meter Readings. About the same time that K4VNK was plugging the 6AC7 in his SX-99, John, W9BDG, and Russ, W9CC, found that substituting a 6DE6 for the 6CB6 r.f. amplifier tube in their SX-101A's raised S-meter readings 20 db and reduced background noise appreciably. Then, a few days later, Chuck, K9JKK, and Mac, K9HMC, reported similar results from replacing the 6BZ6 r.f. amplifier tube in their Hammarlund HQ-170's with a 6DE6.

Frankly, after I checked the transconductance and calculated noise figures of the three tubes, I found them to be almost identical. So I just filed the information. But W9BDG kept extolling the virtues of the 6DE6 until I finally got one and tried it in place of the 6BZ6 in a Heathkit Mohawk receiver. This is what happened:

The S-meter readings increased about two S-units on all bands. In addition, on 28 mc., very weak signals were a little easier to copy, and a measurement with a noise generator showed a slightly better noise figure for the receiver than before.

On the lower frequency ham bands, however, there was no improvement in signal-to-noise ratio in spite of the higher S-meter readings. And when I used my transmitting antenna as a receiving antenna—as I usually do—strong signals overloaded the receiver. This was evidenced by "monkey chatter" up to 20 kc. on either side of the center frequency on strong phone signals and excessive key clicks on strong c.w. sig-

Robert A. Gay, K4YMB, Scottsboro, Ala.



nals. Also, I could hear local hams on several points across the bands. These effects disappeared when I used a short receiving antenna.

I put the 6BZ6 back in the receiver and used the 6DE6 in the signal booster described below.

Other Substitutions. If you would like to experiment with a different amplifier tube in the r.f. stage of your ham receiver, you might try one of the following substitutions. For the 6AU6 or 6BA6, use the 6AH6. Replace the 6BZ6 or 6CB6 with a 6DE6 or a 6DK6. And for the 6SG7, 6SK7, or 6SS7, try the 6AC7.

No wiring changes are required to substitute one tube for another in any of these groups. If you don't like the results, you can immediately return the original tube to its socket. Incidentally, ham receivers selling for less than $100.00 seldom have r.f. stages.

SIGNAL BOOSTER

The r.f. signal booster pictured and diagrammed here can pep up any ham receiver. It will increase sensitivity above 14 mc. approximately five S-units with some receivers. The unit shown was built in a 14-ounce mixed-nuts can because one was available, but it will fit comfortably in a standard 4" x 5" x 3" Minibox. All components are mounted on the cover of the can; refer to the photo as a guide to their positions.

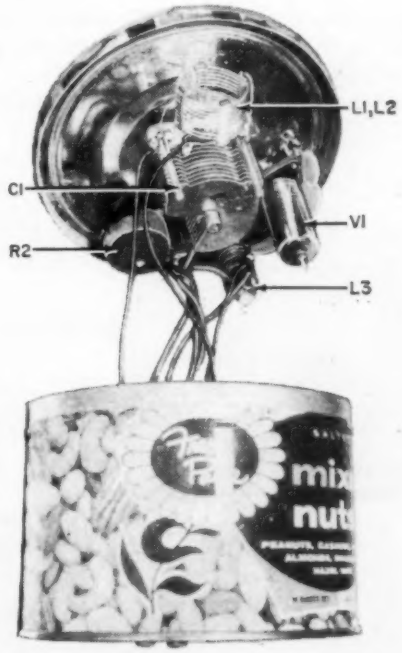
Coils *L1* and *L2* are fabricated from a 10½-turn length of a B & W 3015 "Miniductor." Count off three turns and cut the wire but not the insulation. Unwind ¼-turn from each end of the resulting 3-turn coil, leaving a 2½-turn coil for *L1*. Next,

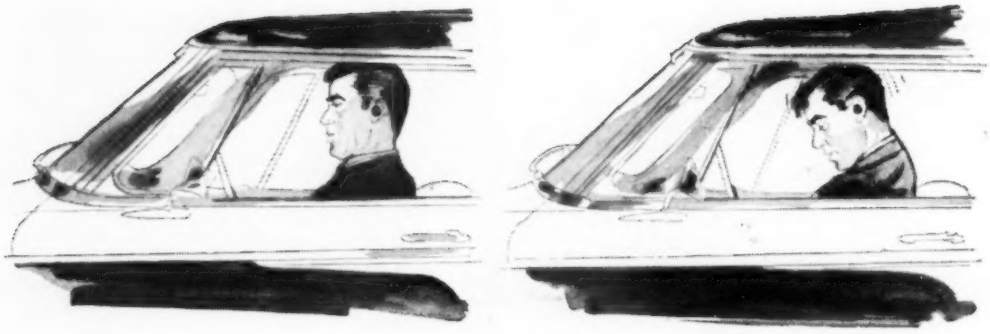
(*Continued on page* 131)

This r.f. signal booster tunes from 14 to 29 mc. with coils specified in text. Power is furnished by the receiver or a small power supply. Potentiometer R2 controls the r.f. gain.

PARTS LIST

C1—140-μμf. midget variable capacitor (Bud 1876 or equivalent)
C2, C3, C4, C5, C6—0.005-μf., 600-volt ceramic disc capacitor
L1—2½ turns of #20 wire, 1" dia., ⅛" from bottom of L2 (part of B & W #3015 Miniductor —see text)
L2—6½ turns of #20 wire, 1" dia. (part of B & W #3015 Miniductor—see text)
L3—1-mh. r.f. choke (National R-300S or equivalent)
R1—100-ohm, ½-watt resistor
R2—2000-ohm, 1-watt potentiometer (sensitivity control)
V1—6DE6 tube
1—4" x 5" x 3" Minibox or equivalent
Misc. terminal strips, tube socket, hookup wire





Transistorized

Easy-to-build co-pilot keeps you awe -n long drives

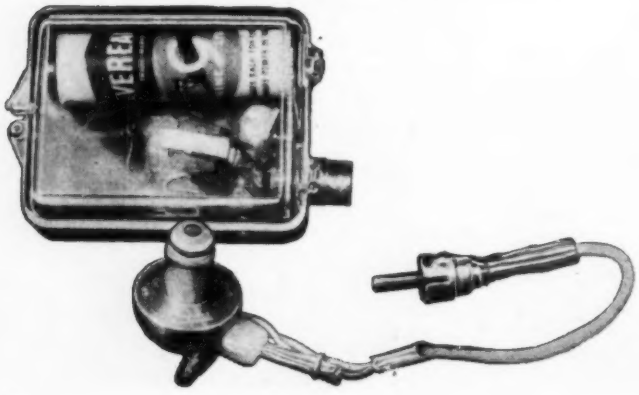
IF YOU'VE EVER found yourself nodding on long drives—or during classes—you'll be interested in this driver alarm. The complete gadget consists of a one-transistor oscillator in a plastic case plus an earphone and miniature mercury switch.

The mercury switch is the heart of the device and the secret of the alarm's action. Affixed to the headphone, it switches on the oscillator whenever the user begins to nod. The volume and harshness of the generated tone (it's loaded with harmonics) would have awakened Rip Van Winkle if transistors and mercury switches had been available in his day.

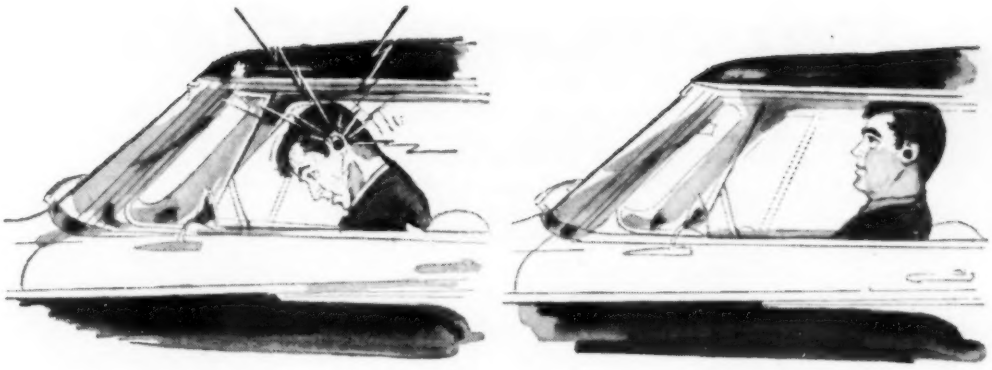
You can construct the gadget in any sort of container you wish. Since the circuit consists of only three components, detailed instructions are superfluous. Just make sure that the transistor and battery polarities are correct and that you follow the transformer color code accurately.

Solder the transistor directly into the

Store the unit in the glove compartment of your car with earphone unplugged. It will be ready for those long trips when you're liable to doze off.



Glue the switch to the back of the earphone so that the switch length is perpendicular to the wires leaving the earphone. Take care in soldering the leads from the earphone as they are delicate.



Driver Alarm

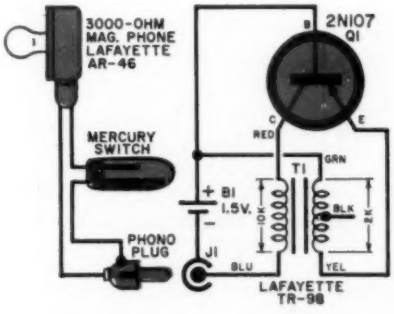
By DAVE GORDON

circuit, and leave its leads long to avoid heat damage. Use two or three miniature alligator clips clipped to the transistor lead as a heat sink and a hot well-tinned iron for rapid soldering.

The transformer, the penlight cell, and the rubber grommet in which the transistor is mounted are all glued to the plastic case. Glue the mercury switch to the rear of the earphone at an angle that will provide convenient operation. (The mercury switch can be purchased from City Electric Distributors, 510 West 34th St., N. Y. 1, N. Y., for $1.36, including postage. Specify Microswitch AS408A1.)

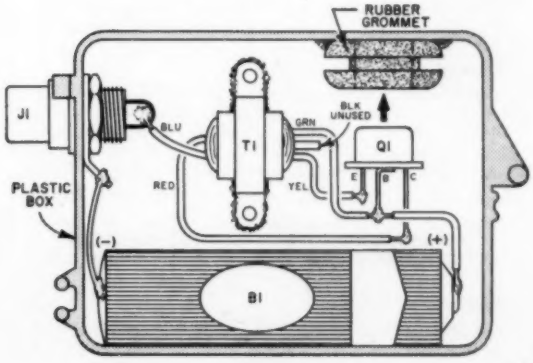
In use, the earphone is rotated in the ear until there is an absence of tone when the head is held upright. A slight nod should then trigger the oscillator.

When this gadget starts to sound off while you're driving, it is far safer to pull over to the side of the road and catch 40 winks than to continue to drive. —30—



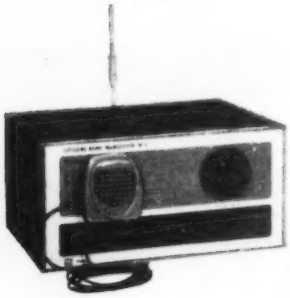
Actual alarm is one-transistor feedback oscillator. The center tap of the transformer (black lead) is not used. Install a Switchcraft 3501 FP phono jack and attach a mating plug on the earphone leads. Note that the mercury "shorts" the two internal contact rods in the switch, completing the oscillator circuit. There is no drain on the battery when the switch is open.

Transformer connections constitute most of the wiring. After the transistor is soldered, it is pushed into the rubber grommet which is glued to the side of the container.



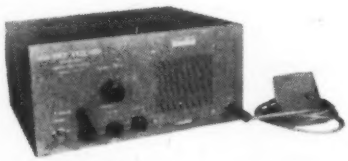
Roundup of Citizens

The tremendous response of the public to the creation of the Citizens Band has encouraged many manufacturers of communications equipment to design transceivers for use on this band. As a service to our readers, POPULAR ELECTRONICS contacted the manufacturers of Citizens Band units for specifications and prices on all models presently available. This information is presented on the following pages with the companies in alphabetical order. Unless otherwise noted, all transceivers have the legal maximum of 5 watts input to the final.



Knight-Kit C-11

Apelco AR-9



Arkay SQ-9

Acton TCV-271

ACTON LABORATORIES, INC.
533 Main St., Acton, Mass.

Model TCV-271

Single-channel receiver and transmitter; crystal-controlled dual-conversion superhet receiver with r.f. and i.f. stages; crystal-controlled transmitter; noise limiter and squelch circuits; includes carbon microphone; 12" x 4" x 6"; 9 lb.

TCV-271 ..... $179.95
TCV-2 (tunable receiver, 3-channel xmtr): $189.95

ALLIED RADIO CORP. ("KNIGHT-KIT")
100 N. Western Ave., Chicago 80, Ill.

Model C-11 Kit

Single-channel 3-tube transmitter with 4-tube tunable superregenerative receiver; operates on 117 volts a.c. or from 6/12-volt d.c. power supply (not incl.).

C-11 Kit $39.95

Model C-27 Kit

Two transmit channels coupled with tunable 8-tube dual-conversion superhet receiver; receiver has one crystal-controlled channel in addition to tunable section; transmitter has 4 tubes; adjustable squelch and noise limiter; operates on 117 volts a.c. or from 6/12-volt power supply (not. incl.).

C-27 Kit $79.95

APPLIED ELECTRONICS CO., INC. (APELCO)
213 E. Grand Ave., South San Francisco, Calif.

Model AR-9

Five-channel crystal-controlled transmitter and receiver; noise limiter and squelch circuits; receiver has r.f. and i.f. stages; models available for operation with 117 volts a.c. or 12 and 32 volts d.c.; includes carbon microphone and crystals for one channel; 9½" x 5¼" x 11½"; 18 lb.

AR-9 ..... $169.50

ARKAY INTERNATIONAL INC.
88-06 Van Wyck Expressway, Richmond Hill 18, N. Y.

"Sky Vox" Model SQ-9

Three crystal-controlled channels for transmit and receive; superhet receiver with automatic noise limiter, adjustable squelch, channel switch; operates on either 12 volts d.c. or 117 volts a.c.; 11⅜" wide, 5⅜" high, 9" deep; prewired and calibrated transmitter.

SQ-9 Kit ..... $ 79.95
SQ-9 Wired $119.95

CHICKASHA ELECTRONICS, INC.
Chickasha, Okla.

Custom Dispatcher Model

Double-channel unit having 6-tube superhet receiver and 4-tube transmitter; adjustable squelch; operates from all voltages; built-in noise limiter.

Custom Dispatcher, Kit $69.95
Custom Dispatcher, Wired $89.95

Model 1000-D

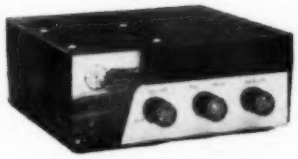
Same features as Custom Dispatcher but has tunable receiver which tunes all CB channels plus 10-meter ham band.

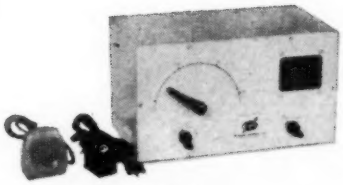
1000-D Kit $59.95
1000-D Wired $79.95

Band Transceivers

Citizen Electronics Model A

Dunlap SCBT-1





Chickasha 1000-D

EICO 760

CITIZEN ELECTRONICS
P. O. Box 443, Laurelton, N. J.

Model A

Single-channel unit with tunable superregenerative receiver; crystal microphone furnished with unit; convertible to 10-meter ham band; 7" high, 9½" wide, 8" deep.

Model A (117 volts a.c.) $54.95
Model A (117 volts a.c. and 6 volts d.c.) $74.90
Model A (117 volts a.c. and 12 volts d.c.) $74.90

DIXON ELECTRONICS CO.
13444 West McNichols Rd., Detroit 35, Mich.

Model CB-5

Walkie-talkie unit; self-contained batteries; 3 lbs.; 3" deep, 4" wide, 11" high; 3-tube transmitter circuit; superregenerative receiver which is tunable over entire band; 20-hour battery life; one-mile range between units or 3 miles between unit and fixed station; telescopic antenna on cabinet; less than 5 watts input to final.

CB-5 Wired $49.95
CB-5 Kit $34.95

DUNLAP ELECTRONICS, INC.
764 Ninth St., Des Moines 14, Iowa

Model SCBT-1 Standard

Seven-tube single-channel receiver combined with 2-tube single-channel transmitter; adjustable squelch; transmit/receive switch on front panel; 3¼" high, 8" deep, 9⅞" wide; etched-circuit chassis. Choice of 117-volt a.c., 6-volt d.c., or 12-volt d.c. models.

SCBT-1 Wired $114.50
SCBT-1 Kit ..... $ 72.50

Model DCBT-1 De Luxe

Same as SCBT-1 but with push-to-talk feature.

DCBT-1 Wired $124.50
DCBT-1 Kit ..... $ 79.50

Model CCBT-1

Same as DCBT-1 but trunk mounting in mobile unit; remote control head; shock-mounted base; operates on two transmit/receive channels.

CCBT-1 Wired $152.50
CCBT-1 Kit $120.00

EICO
33-00 Northern Blvd., L. I. C. 1, N. Y.

Model 760 Kit

Tunable superhet receiver utilizing 6 tubes; 2-tube transmitter; noise limiter on/off switch; operates on 117 volts a.c.; one transmit channel.

760 Kit $59.95*

Model 761 Kit

Same features as Model 760 except for 117 volts a.c. and 6 volts d.c.

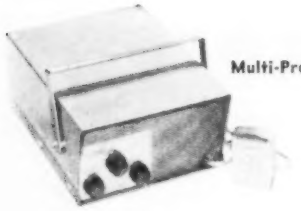
761 Kit $64.95*

Model 762 Kit

Same features as Model 760 except for 117 volts a.c. and 12 volts d.c.

762 Kit $64.95*

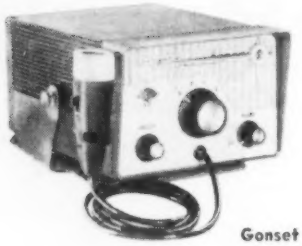
*Anticipated price—wired units will be available but prices not announced at press time



Multi-Products CD-5

International "Executive"

Hallicrafters CB-1



Gonset G-12

Hershel Detrola 22

ELECTRONICS DESIGN CO. (EDCO)

400 E. Cornell St., Enid, Okla.

Model 100-C "Unicom"

Single-channel transmitter and receiver; crystal-controlled superhet receiver with r.f. amplifier and two i.f. stages; noise limiter and squelch; crystal-controlled transmitter; 11¼" x 10½" x 9½"; 15 lb.; models available for 117 volts a.c., 6 volts d.c., or 12 volts d.c.

100-C (a.c. model) $235.00

GLOBE ELECTRONICS

22-30 South 34th St., Council Bluffs, Iowa

Model CB-100

Three transmit/receive channels which are indicated on front panel by colored lights; 7-tube superhet receiver; 3-tube transmitter; adjustable squelch; designed for either home or mobile use; operates on all voltages; has carrying handle, external speaker jacks.

CB-100 ..... $129.95

GONSET (Div. of Young Spring & Wire Corp.)

801 S. Main St., Burbank, Calif.

Model 3303/G-11 Citizens Communicator

Single-channel unit utilizing 9 tubes; superhet receiver with adjustable squelch circuit; "magic-eye" transmitter indicator shows if transmitter is radiating properly; 5¼" high, 6¾" wide, 6¾" deep; 117-volt a.c. operation.

3303/G-11 ..... $124.50

Model 3304/G-11 Citizens Communicator

Same as 3303, except for 12-volt d.c. operation.

3304/G-11 ..... $124.50

Model 3313/G-12 Citizens Communicator

Similar to 3303 but has 4 transmit/receive channels; 4½" high, 7" wide, 10" deep; 11 lb.; operates on both 117 volts a.c. and 12 volts d.c.

3313/G-12 ..... $149.95

GROVE ELECTRONICS MANUFACTURING CO.

4103 W. Belmont Ave., Chicago 41, Ill.

Model G110

Single-channel 4-tube transmitter with 3-tube superregenerative receiver; operates on 117 volts a.c.

G110 Wired $59.95
G110 Kit $39.95
G6 (6 volts) Wired $59.95
G6 Kit $39.95
G12 (12 volts) Wired $59.95
G12 Kit $39.95

HALLICRAFTERS

4401 W. Fifth Ave., Chicago 24, Ill.

Model CB-1

Fixed-frequency superhet receiver with r.f. stage and two i.f. amplifiers; uses 7 tubes; 4-tube single-channel transmitter with special built-in shielding and filtering to reduce harmonic radiation; low-pass filter in antenna circuit; 14½ lb.; 8 3/16" deep, 13 5/16" wide, 6⅞" high; operates on 117 volts a.c.

CB-1 ..... $129.00

HEATH COMPANY

Benton Harbor, Mich.

Model CB-1

Tunable 3-tube superregenerative receiver with r.f. stage and single-channel transmitter; 8" high; 6" deep, 9¾" wide; 10 lb.; transmit switch has two positions, one for rapid break-in, one for "hand-free" transmissions; vibrator power pack (not incl.) required for 6- or 12-volt d.c. operation.

CB-1 Wired $60.95
CB-1 Kit $42.95

HERSHEL RADIO CO. (Detrola Radio Div.)

5249 Grand River, Detroit 8, Mich.

Model 22 Detrola Kit

Single-channel 4-tube transmitter with 4-tube tunable regenerative receiver; 11" wide, 6½" high, 7" deep; 11½ lb.

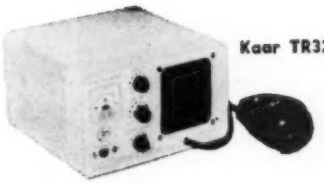
Model 22-110 (117 volts a.c.) $39.95
Model 22-110-6 (117 volts a.c. and 6 volts d.c.) $49.95
Model 22-110-12 (117 volts a.c. and 12 volts d.c.) $49.95
(Add $20 for factory-wired models)

INTERNATIONAL CRYSTAL MANUFACTURING CO.

18 N. Lee St., Oklahoma City, Okla.

"Executive" Citizen Bander

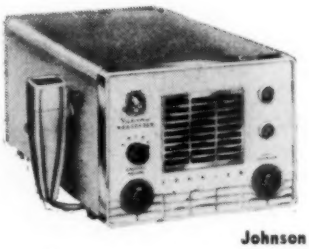
Nine-tube dual-conversion superhet receiver; can be fully tuned or set to two crystal-controlled receive frequencies;



Kaar TR326

Heath CB-1

Lafayette HE-15



Johnson Viking "Messenger"

Globe CB-100

4-tube transmitter operates on any one of 3 channels, selectable from the front panel; universal power supply allows operation on 117 volts a.c., 12 volts d.c., or 6 volts d.c.; adjustable squelch.

"Executive" Citizen Bander *$169.95*

KB-1 Citizen Bander

Eight-tube dual-conversion superhet receiver tunes all channels; 4-tube transmitter for any one channel; adjustable squelch; convertible to ham use.

KB-1 Wired, 3-way power supply *$124.50*
KB-1 Kit, 117 volts a.c ..... *$ 90.00*
KB-1 Kit, 3-way power supply ..... *$ 98.00*

E. F. JOHNSON CO. (Distributed by G.E.)

Waseca, Minn.

Model 242 Viking "Messenger"

Five crystal-controlled channels for transmit and receive; superhet receiver with automatic noise limiter, adjustable squelch; pi-network permits loading into any antenna without tuning the unit; 5⅝" high, 7" wide, 11⅜" deep.

Model 242-126 (117 volts a.c.) *$129.75*
Model 242-127 (117 volts a.c. and 6 volts d.c.) *$139.75*
Model 242-128 (117 volts a.c. and 12 volts d.c.) *$139.75*

KAAR ENGINEERING CORP.

2995 Middlefield Rd., Palo Alto, Calif.

Model TR326 "D" Phone

Dual-channel transceiver with "S" meter for measuring strength of incoming signal; superhet receiver has r.f. gain control and adjustable squelch; 8¾" wide, 5" high, 8" deep; 10 lb.; receiver features highly selective circuit, automatic noise limiter, automatic volume control.

12TR326 (12 volts d.c.) *$179.00*
117TR326 (117 volts a.c.) *$179.00*

LAFAYETTE RADIO CORP.

165-08 Liberty Ave., Jamaica 33, N. Y.

Model HE-15

Five-channel crystal-controlled transmitter; tunable superhet receiver; squelch noise limiter; operates on 117 volts a.c.; includes crystal microphone and one transmitting crystal; 10¼" x 5½" x 6⅜".

HE-15 ..... *$59.95*

MAXWELL ELECTRONICS CORP.

229 Garvon St., Garland, Texas

Model 27C RADIOCOM

Single-channel transmitter and receiver; 8 transmit tubes; 4 receive; transistor power supply with toroid transformer; 3½" high, 7⅛" wide, 11¼" deep; 6 lb.; receiver is single-conversion superhet with 2 r.f. stages; variable squelch; 0.1-microvolt sensitivity; printed circuit.

27C-1A for 12 volts d.c. *$159.50*
27C-1B for 117 volts a.c *$159.50*
27C-1C for 6 volts d.c *$159.50*

MORROW RADIO MANUFACTURING CO.

2794 Market St., Salem, Ore.

Model 5W3

Three transmit/receive channels; 3-tube transmitter; 7-tube superhet receiver with squelch; available in either 6-volt d.c., 12-volt d.c., or 117-volt a.c. models.

5W3 ..... *$179.50*

Model 5W1

Same as 5W3 but has one transmit/receive channel.

5W1 ..... *$169.50*

Model CBFL

Portable version of 5W1.

CBFL *$215.00*

MULTI-PRODUCTS COMPANY ("ELMAC")

21470 Coolidge Highway, Oak Park, Mich.

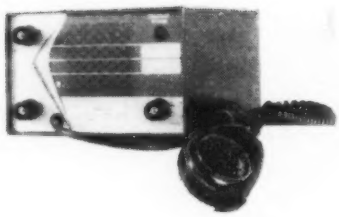
Model CD-5 Citi-fone

Five channels for transmitting and receiving; 7-tube superhet receiver with i.f. section printed on etched-wiring board; 2-tube transmitter; furnished with cigarette lighter plug for mobile operation; 4½" high, 11" deep, 8" wide; 12 lb.; comes with mobile mounting bracket/carrying handle.

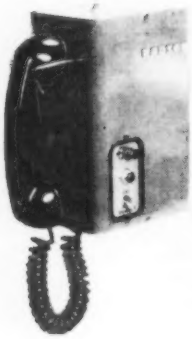
CD-5/6 (117 volts a.c. and 6 volts d.c.) *$124.50*
CD-5/12 (117 volts a.c. and 12 volts d.c.) *$124.50*

(Continued on next page)

Polytronics PC-II

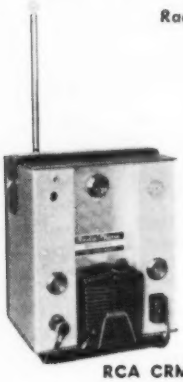


Pearce-Simpson CBD-1



Radson RT-70

RME 4303



RCA CRM-P2B-5

Radio Shack CBK-1

PEARCE-SIMPSON, INC.
2295 N. W. 14th St., Miami, Fla.

Model CBD-1

Single-channel transmitter and receiver; fixed-tuned crystal-controlled superhet receiver; crystal-controlled transmitter; operates on either 117 volts a.c. or 12 volts d.c.; 7" x 4 5/16" x 10"; 10 lb.; includes carbon mike.

CBD-1 ..... $159.50

PHILMORE MANUFACTURING CO., INC.
130-01 Jamaica Ave., Richmond Hill 18, N. Y.

Model TC-11 Kit

Five-tube 3-channel transceiver with superregenerative receiver circuit; optional antenna-jack mounting position so any type of antenna may be used; 10" wide, 4 1/8" high, 10 7/8" deep; weighs 10 lb.

TC-11 Kit (117 volts a.c.) $39.95
TC-612 Kit (6 and 12 volts d.c.) $44.49

POLYTRONICS LABORATORIES, INC.
253 Crooks Ave., Clifton, N. J.

Poly-Comm II

Four-channel unit with 4-tube transmitter and 9-tube dual-conversion receiver; adjustable squelch and 0.5-microvolt sensitivity; noise limiter; teflon-insulated wiring throughout; no relays in transmit/receive switching circuit; 5" high, 7 1/2" deep, 11" wide; 12 3/4 lb.

PC-II-6 (117 volts a.c. and 6 volts d.c.) $179.50
PC-II-12 (117 volts a.c. and 12 volts d.c.) $179.50

RME (Radio Mfg. Engineers, Inc.)
Washington, Ill.

Model 4303

Walkie-talkie unit with self-contained battery; all-transistor circuit with superhet receiver tunable over entire band; 7 transistors plus 1 diode; manufacturer claims CB license not required; one transmit channel; 43" whip antenna on top of unit; less than 5 watts input to final.

4303 ..... $129.50

RADIO CORPORATION OF AMERICA
Industrial Electronics Products, Camden 2, N. J.

Model CRM-P2B-5

Single-channel unit with provision for manual tuning of receiver by unplugging receiver crystal; 3-tube transmitter; 6-tube superhet receiver.

For 117 volts a.c. and 6 volts d.c. $159.95
For 117 volts a.c. and 12 volts d.c. $159.95

RADIO SHACK CORP.
730 Commonwealth Ave., Boston 17, Mass.

Model CBK-1 Kit

Five-tube transceiver with one transmit channel and tunable regenerative receiver; operates from 117 volts a.c.

CBK-1 Kit $39.95

RADSON ENGINEERING CORP.
Macon, Ill.

Model RT-70

Single-channel transmitter and receiver; fixed-tuned crystal-controlled superhet receiver with r.f. stage and two i.f. stages; crystal-controlled transmitter; 9 1/2" x 6" x 4"; 9 lb.; includes carbon microphone.

RT-70 (117 volts a.c.) $149.95
RT-75 (6 or 12 volts d.c.) $159.95

RAY JEFFERSON, INC.
40 E. Merrick Rd., Freeport, L. I., N. Y.

Model 905

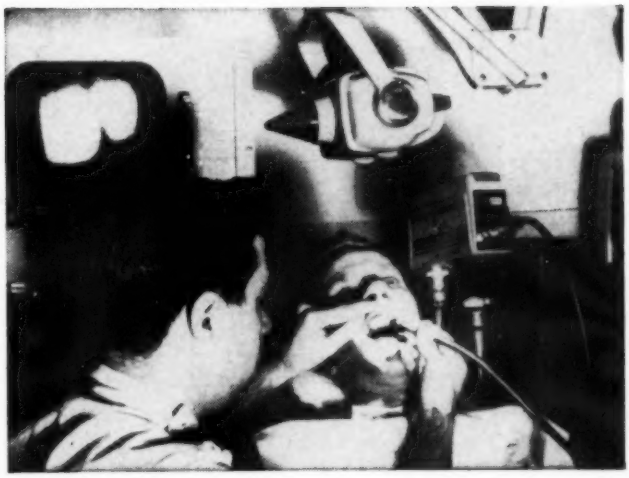
Five-channel crystal-controlled transmitter with tunable superregen receiver; models available for operation on 117 volts a.c., 6 volts d.c., or 12 volts d.c.; includes microphone and crystal for one channel; 8 1/8" x 6 3/4" x 8 1/2"; 12 lb.

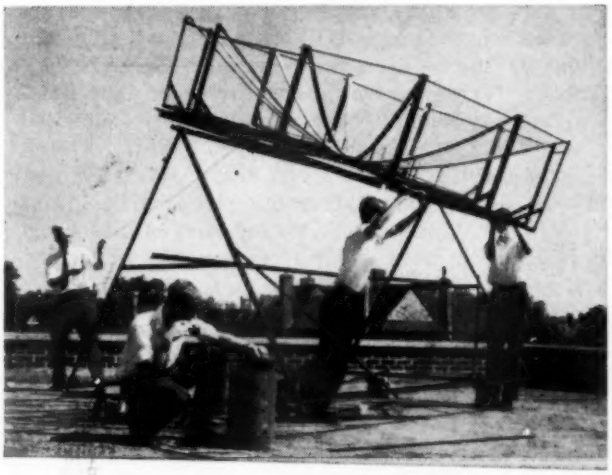
905 ..... $99.50

(Continued on page 118)

TV AIDS DENTIST

A new closed-circuit TV system designed especially for dental use has been developed by Avco Corporation under the sponsorship of the U. S. Navy. It permits a dentist to view magnified images of any part of a patient's mouth. A cable containing 10,000 light-transmitting fibers links the probe to the pickup camera. (UPI photo)





HOME-BUILT RADIO TELESCOPE

Some British schoolboys at Dartford Grammar School in Kent recently pooled their knowledge and resources to build this working radio telescope—in about a year's time. They have already picked up signals from the Milky Way, the Sun, and the constellation Sagittarius. (Photo courtesy Eastern Publishers Service)

TYPEWRITER TRANSMITTER

Designed for emergency use, this new typewriter-like transmitter permits a person who has no knowledge of Morse code to send code messages simply by pressing the appropriate keys. Invented by Leif Evensen, a Norwegian radio operator, it is manufactured in Gothenburg, Sweden. (UPI photo)

By
JOHN T. FRYE
W9EGV

Carl and Jerry

A Hot Idea

THE BUFFETING March wind spanked Carl with the slamming basement door as he stepped into the electronic laboratory of his friend, Jerry. The latter was sitting with his head encased in a pair of muff-type earphones connected to an amplifier with a variable frequency audio oscillator working into its input. As Carl looked at his chum aimlessly adjusting the frequency of the oscillator and the gain of the amplifier, he decided there was something about Jerry's appearance that was not right. There was a certain lackluster look about his eyes, and his round face looked fatter than ever—but in a sort of lopsided way.

"Guess I'm the one guy in ten for whom it won't work," Jerry said with a lugubrious sigh as he shut off the equipment and removed the earphones.

"What won't work, and what's the matter with your face? It looks twice as big as it ought to."

"The 'audio anesthetic' won't work for me. I've got an infected wisdom tooth that's killing me, and I have an appointment with the dentist in an hour. But the other day I read that a Boston dentist discovered that music or random noise put into earphones worn by a patient killed the pain of dental work in 90% of 2000 cases tested. The patient adjusts the sound level with a gain control in his lap until the sound blocks out the pain sensation. A company in Rochester is already in production on the device. I was trying to see if I could kill the pain of my toothache with various frequencies from the audio generator, but I couldn't."

"That thing must work on a variation of the 'mule skinner' principle," Carl said. "You know a veteran mule skinner always took the ear of a mean mule between his teeth and bit down hard while he was putting on the bridle. The idea was that while the mule was thinking about how much his ear hurt he couldn't think about kicking or biting the mule skinner. With the audio anesthetic, while the mind is concentrating on the sound it ignores the pain. Your trouble is that in fooling around with ham radio, etc., you've trained yourself to be a *little* smarter than the mule. You can listen and still be thinking about your aching tooth at the same time. Well, I better scram and let you go to the dentist."

"Oh, no, you don't!" Jerry exclaimed. "I've a little chore for you to perform while I'm gone; and I just know you wouldn't refuse your poor, pain-wracked buddy."

"Depends on what my poor, pain-wracked, scheming buddy has in mind."

"All I want you to do is mount this ther-

mistor anemometer out on the garage and run this cable from it back into the lab."

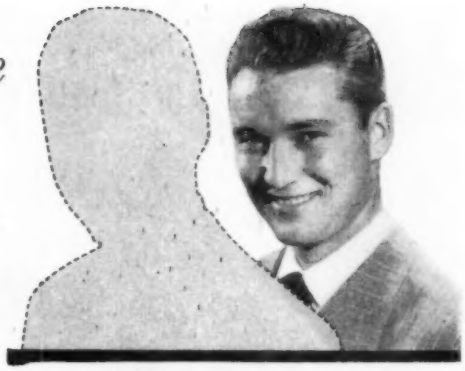
"You know," Carl said thoughtfully, "I don't think you've got a toothache at all. You've just dislocated your jaw on one of those big words you're so fond of. What the heck is a 'Mistermometer'?"

"I said a 'thermistor anemometer.' As you know, or should know, an anemometer is a device for measuring wind velocity. This one is intended to do so by the use of thermistors. A 'thermistor' is a resistor

(*Continued on page* 114)

Compare your job, your age your pay, with that of

men who enroll at CREI



. . . then consider how handicapped you'll be without the knowledge of advanced electronics engineering technology which CREI teaches via home study

Men can stand still—or lose their jobs—even in a growing industry. They're doing it now in the fast-growing electronics industry. Companies actively seeking men with advanced technological knowledge are simultaneously firing mediocre men.

CREI students (more than 20,400 are currently enrolled) keep pace with electronics progress—and are eagerly sought by employers who offer solid opportunities for rapid advancement.

We analyzed the backgrounds of men who enrolled for CREI advanced electronics home study in a recent month. Compare yourself:

- 62% were civilians. 38% were in the Armed Services.
- Of the 62% who were civilians, 35% were electronic technicians, lab technicians, engineering aides, research assistants, electronic specialists, and similar high-rated electronics engineering men.
- Average pay: $435 per month (range: $300 to $900). Average age: 28. Median age: 26. Previous formal electronic training varied from six months to more than a year.
- 9.4% of the civilians were technical representatives—field engineers who were school- or factory-trained to help install, maintain, service and teach the use and operation of electronic equipment. Average pay: $525 per month. Median age: 28.
- 6.5% of the civilians held college degrees, most in a field more or less related to electronics (engineering, physics, chemistry, etc.). These men were not in basic electronic work. Reason most often given for enrollment: to supplement job-know-how with better understanding of electronics.
- The remainder of the civilians were small groups of small percentages.

Even if you compare favorably with new CREI enrollees **now,** how do you think your salary will compare with theirs a year from now? Five years from now?

Qualify for positions which require advanced electronics education—while retaining your present job — via CREI home study. Meet your family responsibilities while gaining knowledge of electronic engineering technology so essential for career advancement. College degree is not essential. If you have had basic electronic education, practical experience in electronics, and a high school education, you can probably qualify. **Use coupon below to find out, or write CREI, Dept. 1203-G, 3224 16th St., N.W., Wash. 10, D. C.**

CREI RESIDENCE SCHOOL IN WASHINGTON, D. C.

For those who can attend classes, CREI operates full time residence school. Day and evening classes start at regular intervals. Qualified graduates earn AAS degree. Electronics experience not required for admission.

Get This New Fact-Packed Booklet—It's Free!

CAPITOL RADIO ENGINEERING INSTITUTE
ECPD Accredited Technical Institute Curricula • Founded 1927
Dept. 1203G, 3224 Sixteenth St., N.W., Washington 10, D. C.

Please send me your course outline and FREE illustrated Booklet "Insurance for Your Future in the New World of Electronics" . . . describing opportunities and CREI home study courses in Practical Electronic Engineering Technology.

CHECK FIELD OF GREATEST INTEREST
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- ☐ Electronic Engineering Technology
- ☐ Communications Engineering Technology
- ☐ Television Engineering Technology
- ☐ Aeronautical Electronic Engineering Technology
- ☐ Automation and Industrial Electronics Engineering Technology

Name _____ Age _____
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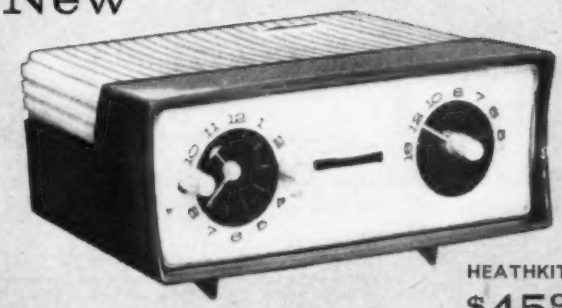
HEATHKIT®

Transistor Clock Radio Kit

New



HEATHKIT TCR-1
$45.95

LEATHER CARRYING CASE
HEATHKIT No. 93-3
Shpg. Wt. 2 lbs.
$4.95

Everything A Clock Radio Can Offer And Portable Too!

- Completely portable, all transistor circuit
- Runs up to 500 hours on standard batteries
- Deluxe features at half the cost
- Easy to assemble—even by beginners

"YOUR CUE" TRANSISTOR CLOCK RADIO KIT (TCR-1)

Take all the deluxe features found in the most expensive clock-radios, add the convenience of complete portability, plus a modern 6-transistor battery operated circuitry . . . then slash the price at least in half, and you have the new HEATHKIT "Your Cue", Transistor Portable Clock Radio.

Packing every modern clock-radio feature into a compact, beautifully styled turquoise and ivory plastic cabinet, "Your Cue" lulls you to sleep, wakes you up, gives you the correct time and provides top quality radio entertainment any time, any place. It can also be used with the Heathkit Transistor Intercom system, below, to provide music or a "selective alarm" system.

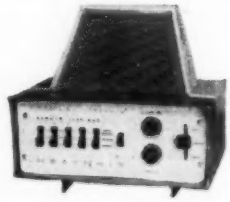
An "alarm-set" hand, hour hand, minute hand and sweep second hand grace the easy-to-read clock dial. The "lull-to-sleep" control sets the radio for up to an hour's playing time, automatically shutting off the receiver when you are deep in slumber. Other controls set "Your Cue" to wake you to soft music or conventional "buzzer" alarm. A special earphone jack is provided for private listening or connection to your intercom or music system.

Six easily obtainable penlight-size mercury batteries power the radio receiver up to 500 hours, while the clock operates up to 5 months from a single battery of the same type. Ordinary penlight cells may also be used with reduced battery life. The handsome two-tone cabinet, measuring only 3½" H. x 8" W. x 7½" D. fits neatly into the optional carrying case for beach use, boating, sporting events, hunting, hiking or camping. Shpg. Wt. 5 lbs.

Transistor Intercom Kit

Master unit can call any one, any combination, or all five remote stations. Remote stations can turn system "on" and call another. Each remote unit equipped with "privacy" switch. Master unit can be connected to new transistor clock-radio shown above (or any radio not AC-DC operated) to supply music or alarm to system; separate listen and talk volume controls; handsome case of two-tone ivory and turquoise high-impact plastic. Remotes are "look-alike" miniatures of master. Eight flashlight batteries power system up to 300 hours. Master and remotes sold separately; order up to five remote stations for each master station ordered.

INTERCOM AC POWER SUPPLY (XP-1): Adapts Intercom for permanent operation from household AC current. Fits in space normally occupied by battery supply. Shpg. Wt. 2 lbs. Heathkit XP-1 $9.95



BATTERIES NOT INCLUDED

HEATHKIT XI-1 Master. Shpg. Wt. 6 lbs. $27.95

HEATHKIT XIR-1 Remote. Shpg. Wt. 4 lbs. $6.95

HEATH COMPANY / Benton Harbor, Michigan — a subsidiary of Daystrom, Inc.

New HEATHKIT Stereo Amplifiers

14/14-WATT STEREO AMPLIFIER KIT (SA-2)

A complete dual channel amplifier/preamplifier combination the new Heathkit SA-2, in one compact, handsomely styled unit provides all the modern features required for superb stereo reproduction . . . yet is priced well within your budget.

The SA-2 delivers 14 watts per stereo channel, and 28 watts total monophonic. Maximum flexibility is provided by the 6-position function switch which gives you instant selection of "Amp. A" or "Amp. B" for single channel monophonic; "Mono. A" or Mono. B" for dual channel monophonic using either preamp with both amplifiers; and "stereo" or "stereo reverse". A four position input selector switch provides choice of magnetic, phono, crystal phono, tuner, and an extra high level auxiliary input for use with tape recorder, TV, etc. The magnetic input is RIAA equalized and features 3 mv sensitivity—adequate for the lowest output cartridges available today.

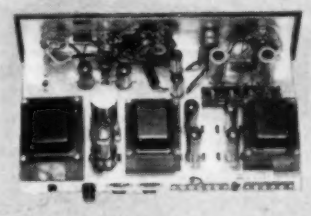
The dual-concentric volume control is equipped with a friction clutch which can be set to lock the two controls together once the balancing of the two amplifiers has been accomplished.

Ganged dual tone controls adjust bass and treble response of both channels simultaneously. Proper speaker phasing may be conveniently accomplished with the speaker phase reversal switch located on the rear chassis apron. A hum balance control is provided for each channel. Two AC outlets, one controlled by the power switch, provide convenient accommodation for accessory equipment. As beautiful as it is functional, the SA-2 features the latest Heathkit styling in vinyl-clad steel with leather-like texture in black with inlaid gold design. Shpg. Wt. 23 lbs.

SPECIFICATIONS—Power output: 14 watts per channel, "hi-fi"; 12 watts per channel, "professional"; 16 watts per channel, "utility". **Power response:** ±1 db from 20 cps to 20 kc at 14 watts output. **Total harmonic distortion:** less than 2%, 30 cps to 15 kc at 14 watts output. **Intermodulation distortion:** less than 1% at 16 watts output using 60 cps and 6 kc mixed 4:1. **Hum and noise:** mag. phono input, 47 db below 14 watts; tuner and crystal phono, 60 db below 14 watts. **Controls:** dual clutched volume; ganged bass, ganged treble; 4-position selector; speaker phasing switch. **AC receptacle:** 1 switched; 1 normal. **Inputs:** 4 stereo or 4 monophonic. **Outputs:** 4, 8 and 16 ohms. **Dimensions:** 4½" H. x 15" W. x 8" D. **Power requirements:** 117 volts, 50/60 cycle, AC, 150 watts (fused).

best stereo buy ever!

HEATHKIT SA-2
$52.95



ECONOMY STEREO AMPLIFIER KIT (SA-3)

This amazing performer delivers more than enough power for pure undistorted room-filling stereophonic sound at the lowest possible cost. Featuring 3 watts per stereo channel and 6 watts as a monophonic amplifier, the SA-3 has been proven by exhaustive tests to be more than adequate in volume for every listening taste. You will find its ease of assembly another plus feature. Heathkit construction manuals, world famous for their clarity and thoroughness, lead you a simple step at a time to successful completion of the kit. Tastefully styled in black with gold trimmed control knobs and gold screened front and rear panel. A tremendous buy at this low Heathkit price. Shpg. Wt. 13 lbs.

SPECIFICATIONS—Power output: 3 watts per channel. **Power response:** ±1 db from 20 cps, 20 kc at 3 watts out. **Total harmonic distortion:** less than 3%; 60 cps, 20 kc. **Intermodulation distortion:** less than 2% @ 3 watts output using 60 cycle & 6 kc signal mixed 4:1. **Hum and noise:** 66 db below full output. **Controls:** dual clutched volume; ganged treble, ganged bass; 7-position selector; speaker phasing switch; on-off switch. **Inputs (each channel):** tuner, crystal or ceramic phono. **Outputs (each channel):** 4, 8, 16 ohms. **Finish:** Black with gold trim. **Dimensions:** 12½" W. x 6¾" D. x 3¼" H.

Go stereo for just $29.95

HEATHKIT SA-3
$29.95

New HEATHKIT® Amplifiers

HEATHKIT EA-3
$29.95

"BOOKSHELF" 14-WATT HI-FI AMPLIFIER KIT (EA-3)

Without doubt one of the finest investments you can make in a top quality amplifier and preamplifier combination. Features three switch-selected inputs, separate bass and treble tone controls, RIAA equalization and a special hum balance control. Tastefully styled in black simulated-leather with brushed gold trim. Shpg. Wt. 15 lbs.

NOTE THESE OUTSTANDING SPECIFICATIONS—Power output: Hi-Fi rating 14 watts; Professional rating 12 watts. **Power response:** ±1 db 20 cps to 20 kc at 14 watts output. **Total harmonic distortion:** less than 2%, 30 cps to 15 kc at 14 watts output. **Intermodulation distortion:** less than 1% at 16 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** mag. phono input 47 db below 14 watts; tuner and crystal phono, 63 db below 14 watts. **Output impedances:** 4, 8 and 16 ohms.

HEATHKIT FM-4
$34.95

HIGH FIDELITY FM TUNER KIT (FM-4)

This handsomely styled FM tuner features better than 2.5 microvolt sensitivity, automatic frequency control (AFC) with on-off switch, flywheel tuning and prewired, prealigned and pretested tuning unit. Clean chassis layout, prealigned IF transformers and assembled tuning unit makes construction simple and guarantees top performance. Flywheel tuning and new soft, evenly lit dial scale provide smooth, effortless operation. Housed in attractive vinyl-clad steel case with gold design and trim. A multiplex adapter output is also provided. Your best buy in an FM tuner. Shpg. Wt. 8 lbs.

HEATHKIT UA-2
$22.95

UNIVERSAL 14-WATT HI-FI AMPLIFIER KIT (UA-2)

Living up to its title "universal" the UA-2 performs with equal brilliance in countless Hi-Fi and PA applications. Easily meets 14 watt hi-fi and 12 watt professional standards. Power response is ±1 db from 20 cps to 20 kc at 17 watts output. Harmonic distortion is less than 2% and IM distortion is less than 1% at 14 watts output. Output taps are provided for 4, 8 and 16 ohm speakers. High quality, remarkable economy and ease of assembly make it one of the finest values in high fidelity equipment. Shpg. Wt. 13 lbs.

HEATHKIT W-7A
$54.95

55-WATT HI-FI AMPLIFIER KIT (W7-A)

Best buy in its power class! Combines modern components, unique output transformer, power supply and circuit design to bring you a superb high fidelity amplifier at less than a dollar a watt. Power response is ±1 db from 20 cps to 20 kc at full 55 watt output. Total distortion is less than 2% at full output. Output taps are 4, 8 and 16 ohms plus 70 volt line for use in wired music systems. On-off switch, gain control, and max. or unity damping switch are located on the front panel. Clean, open circuit layout are precut, cabled wiring harness for easy assembly. Shpg. Wt. 28 lbs.

STEREO-MONO PREAMP KIT (SP-2A, SP-1A)

Available in two outstanding versions! SP-2A (stereo) and SP-1A (monophonic). SP-1A convertible to stereo with conversion kit C-SP-1A. Use as the control center of your entire high fidelity system. Six inputs in each channel accommodate most any program source. Switch selection of NARTB or RIAA, LP and 78 rpm record compensation.

HEATHKIT SP-2A (two-channel stereo). Shpg. Wt. 15 lbs.	**$56.95**
HEATHKIT SP-1A (single-channel monophonic). Shpg. Wt. 13 lbs.	**$37.95**
HEATHKIT C-SP-1A (converts SP-1A to SP-2A). Shpg. Wt. 4 lbs.	**$21.95**

New HEATHKIT Tape Recorders

Have fun making your own recordings with one of these outstanding tape recorder kits

STEREO MONO TAPE RECORDER KITS

Our most versatile tape recorder kit, you can buy the new two-track (TR-1AH) or four-track (TR-1AQ) versions which record and playback both Stereo and Monophonic programming or the two-track Monophonic record-playback version (TR-1A). Precision bearings and close machining tolerances hold flutter and wow to less than 0.35%. NARTB equalization, separate record and playback gain controls and a safety interlock. Provision for mike or line inputs with 6E5 "magic eye" tube as sound level indicator.

MODEL TR-1A: Monophonic two-track record/playback with fast forward and rewind functions. Includes the TE-1 Tape Electronics Kit. Shpg. Wt. 24 lbs. $10.00 DN., $9.00 MO. **$99.95**

MODEL TR-1AH: Two-track monophonic and stereo record/playback with fast forward and rewind functions. Two TE-1 Tape Electronics Kits. Shpg. Wt. 26 lbs. $15.00 DN., $13.00 MO. **$149.95**

MODEL TR-1AQ: Four-track monophonic and stereo record/playback with fast forward and rewind functions. Two TE-1 Tape Electronics Kits. Shpg. Wt. 36 lbs. $15.00 DN., $13.00 MO. **$149.95**

PROFESSIONAL QUALITY TAPE RECORDER KITS

Precision tape mechanism complete and tested, build only the amplifier. Two circuit boards for easy assembly, and high stability. Separate record and playback heads and amplifiers for monitoring while recording. Includes sound level meter, counter, pause control, record interlock, 2 (switch-selected) speeds 3¾ and 7½ IPS. Response: ±2.5 db 30 to 12,000 cps at 7½ IPS. NARTB equalization. Compares to $350 to $400 units. Shpg. Wt. 30 lbs.

MODEL TR-1E: 4-track stereo playback, monophonic record & play. **$169.95**

MODEL TR-1D: 2-track stereo playback, monophonic record & play. **$169.95**

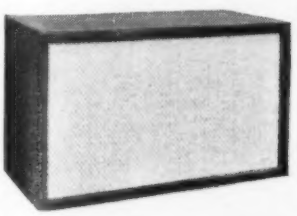
MODEL TR-1C: monophonic record playback. **$159.95**

MODEL C-TR-1D: converts TR-1D to TR-1E, 2 lbs. **$14.95**

MODEL C-TR-1C: converts TR-1C to TR-1D, 2 lbs. **$19.95**

MODEL C-TR-1CQ converts TR-1C to TR-1E, 2 lbs. **$19.95**

New Acoustic Suspension Hi-Fi Speaker System Kit



HEATHKIT AS-2M (mahogany) **$79.95**

HEATHKIT AS-2U (unfinished) **$69.95**

HEATHKIT AS-2B (birch) **$79.95**

The Acoustic Research speaker is accepted as most praiseworthy in the world of hi-fi sound reproduction. Heathkit, sole kit licensee from AR Inc., now offers a kit version of this remarkable speaker system in money saving, easy to build form. The 10" acoustic suspension woofer delivers clean, clear extended range bass response and a specially designed "cross-fired" two-speaker tweeter assembly provides outstanding high frequency distribution. Response at 10 watts input ±5 db from 42 to 14,000 cps. Impedance 8 ohms. Cabinets are preassembled and available prefinished in birch or mahogany and unfinished in furniture-grade birch only. Shpg. Wt. 32 lbs.

HEATH COMPANY / Benton Harbor, Michigan — a subsidiary of Daystrom, Inc.

New HEATHKIT Ham Radio Gear

Maximum power at minimum cost

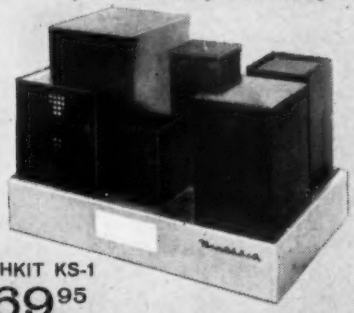
HEATHKIT KL-1
$415.00

"CHIPPEWA" KILOWATT LINEAR AMPLIFIER KIT (KL-1)

Operates at maximum legal amateur power inputs in SSB, CW or AM service using any of the popular CW, SSB and AM exciters as a driver. Premium tubes (4-400's) push the "Chippewa" to top performance levels while a centrifugal blower provides maximum cooling. Shpg. Wt. 70 lbs.

SPECIFICATIONS—RF section: Driving power required (10 meters); Class AB1 (tuned grid) 10 watts peak; Class C (tuned grid) 40 watts; Class AB1 (swamped grid) 8 watts peak. **Power input:** Class AB1 (SSB-voice modulation) 2000 watts PEP; Class AB1 (SSB-two tone test) 1300 watts; Class AB1 (AM linear) 1000 watts; Class C (CW) 1000 watts. **Power output (20 meters):** Class AB1 (SSB-voice modulation) 900 watts PEP; Class AB1 (SSB-two tone test) 550 watts; Class AB1 (AM linear) 300 watts; Class C (CW) 750 watts. **Output impedance:** 50 to 72 ohms (unbalanced). **Band coverage:** 80, 40, 20, 15 and 10 meters **Panel metering:** 0 to 50 ma, grid current; 0 to 100 ma screen current; 0 to 5000 plate voltage, 0 to 1000 ma plate current. **Tube complement:** Final tubes, (2) 4-400A; clamp tube (1) 6DQ6; voltage regulators, (4) OD3, (2) OC3. **Power requirements:** AC (power supply primary circuit), 250 watts, 115 volt, 50/60 cycles; DC, 3000 to 4000 volts, 450 ma. **Cabinet size:** 19½" W. x 11⅞" H. x 16" D.

Top power, plus economy and safety



HEATHKIT KS-1
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KILOWATT POWER SUPPLY KIT (KS-1)

Ideal companion for the "Chippewa" Linear Amplifier . . . and supplies plate power to most other RF amplifiers in medium to high power class. Features oil-filled, hermetically sealed plate transformer and 60 second time delay relay. Shpg. Wt. 105 lbs.

SPECIFICATIONS—Maximum DC power output: 1500 watts. **Nominal DC voltage output:** 3000 or 1500 volts. **Maximum DC current output:** Average 500 ma, peak 1000 ma. **Regulation:** 180 to 600 ma (typical linear amplifier), 8%; 0 to 300 ma (typical class C amplifier), 10%; 0 to 500 ma, 15%. **Ripple:** Less than 1%. **Tube complement:** (2) 866A mercury vapor rectifier. **Recommended ambient temperature:** 50 to 100 degrees F. **Circuit:** Two half-wave mercury vapor rectifiers in a full wave single-phase configuration with swinging choke input filtering. **Line power requirements:** 115 V, 50/60 cycles, 20 amperes; 230 V, 50/60 cycles, 10 amperes. **Chassis size:** 17¾" W. x 12" H. x 13" D.

HEATHKIT XC-2
$36.95

2 METER CONVERTER KIT (XC-2)

Extends coverage of the Heathkit "Mohawk" Receiver to the 2 meter band. Use also with receivers tuning a 4 mc segment between 22 and 35 mc with appropriate crystal. Shpg. Wt. 7 lbs.

HEATHKIT UT-1
$28.95

"BEST BUY" UTILITY POWER SUPPLY KIT (UT-1)

Converts "Cheyenne" and "Comanche" mobile transmitter and receiver to fixed station operation. May also be used to provide filament and plate voltage for wide variety of ham gear. Shpg. Wt. 15 lbs.

New Test Equipment

HEATHKIT FMO-1

FM TEST OSCILLATOR KIT (FMO-1)

Complete FM test facilities in one compact, easy to use instrument. First of its kind on the market.

SPECIFICATIONS—Output frequencies: for RF alignment, 90 mc (FM band low end), 100 mc (FM band middle range), 107 mc (FM band high end). **Modulation:** 400 cycle incidental FM. **IF and detector alignment:** 10.7 mc sweep. **Sweep width markers:** 200 kc to over 1 mc, variable, 10.7 mc (crystal), 100 kc sub-markers. **Modulation:** 400-cycle AM. **For other applications:** 10.0 mc (crystal) and harmonics, 100 kc 400-cycle audio. **Controls:** main frequency selector, modulation switch/concentric level control, marker oscillator switch/concentric level control, sweep width—power switch, output control, AF-RF (source impedance) switch. **Power supply:** transformer, selenium rectifier. **Power requirements:** 105-125 V, 50/60 cycles, 12 watts. **Cabinet size:** 7⅞" H. x 4¾" W. x 4⅜" D.

HEATHKIT RF-1
$27.95

RF SIGNAL GENERATOR KIT (RF-1)

High precision performance . . . for troubleshooting and aligning RF and IF circuits of all kinds. Preassembled and aligned bandswitch/coil assembly. Shpg. Wt. 7 lbs.

SPECIFICATIONS—Frequency range: Band A, 100 kc to 320 kc; Band B, 310 kc to 1.1 mc; Band C, 1 mc to 3.2 mc; Band D, 3.1 mc to 11 mc; Band E, 10 mc to 32 mc; Band F, 32 mc to 110 mc **Calibrated harmonics:** 110 mc to 220 mc. **Accuracy:** 2% **Output:** Impedance, 50 ohms; voltage, in excess of 100,000 uv on all bands. **Modulation:** internal, 400 cycles approx. 30% depth; external, approx. 3 V across 50 k ohm for 30%. **400 cycles audio output:** approx. 10 V open circuit. **Tube complement:** V1 12AT7 RF oscillator, V2 6AN8 modulator and output. **Power requirements:** 105-125 V 50/60 cycles AC, 15 watts. **Aluminum cabinet dimensions:** 6½" W. x 9½" H. x 5" D.

New Citizen's Band Transceiver

WIRED OR KIT FORM!

- No Tests to Take—No Operators License Required
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- Hundreds of Business and Personal Uses

Kit Model, **Heathkit CB-1 $42.95**
Wired Model, **Heathkit W-CB-1 $60.95** ($6.10 dwn. $6.00 mo.)
Both Models Include Transceiver, crystal, microphone and Two Special Power Cords.

CITIZEN'S BAND TRANSCEIVER KIT (CB-1)

Have your own wireless communications system! Make necessary personal contacts with family, friends, or associates from your car, home, boat or office. Light, compact, easy to use, the Transceiver reliably covers distances from one to ten miles depending on location, antenna and type of installation. Transmitter frequency is crystal controlled. Receiver tunes any of the 23 channels assigned to the 11 meter "Citizen's Band". Operates from 117 volt AC line using internal power supply, or from 6 or 12 V. batteries using separate vibrator power supply. Can be transferred in minutes from fixed to mobile operation. All pertinent FCC regulations, and station license application forms are furnished. Comes complete with microphone, two power cords, station identification card, set of stick-on call letters and crystal for one channel. Smartly styled in rich mocha and beige. Shpg. Wt. 10 lbs.

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Good coverage, portable antenna for temporary mobile or fixed installations. Shpg. Wt. 3 lbs.

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Best coverage mobile antenna. 9' whip.
Bumper mount. Shpg. Wt. 7 lbs.

CBF-1 "FIXED LOCATION" ANTENNA **$19.95**
Excellent coverage, ¼ wave, 9' elements. 50' connecting cable and mounting bracket. Shpg. Wt. 7 lbs.

WIRED AND KIT FORM POWER SUPPLIES FOR MOBILE USE OF CB-1

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KIT: **model VP-1-6**, Shpg. Wt. 4 lbs. **$7.95**
WIRED: **model W-VP-1-6**, Shpg. Wt. 4 lbs. **$11.95**

12-VOLT VIBRATOR POWER SUPPLY
KIT: **model VP-1-12**, Shpg. Wt. 4 lbs. **$7.95**
WIRED: **model W-VP-1-12**, Shpg. Wt. 4 lb. **$11.95**

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QUAN.	MODEL NO.	KIT NAME	PRICE

whose resistance changes, in a nonlinear fashion, incidentally, with a change in temperature. The temperature affecting the resistance may arise externally or it may come from current flowing through the thermistor. In the case of these thermistors you see on the bench, an increase from −60 to plus 150 degrees centigrade will cause the resistance to fall from about 2000 ohms to one ohm."

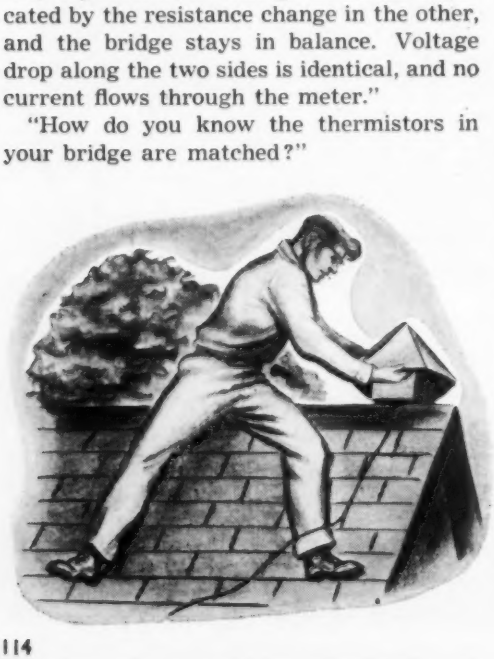
"That sounds dandy for measuring temperature, but I don't see how they can be used to measure wind velocity."

"Keep listening and you will."

"I'VE arranged two matched thermistors and two resistors—one variable—in a bridge circuit," Jerry explained as he sketched the familiar diamond-shaped bridge circuit. "These two top legs are the thermistors; the two bottom legs are the resistors. Here's a battery in series with a switch connected between the common junction of the two thermistors up here and the common junction of the two resistors at the bottom. A d.c. meter connects from this left-hand thermistor-resistor junction across to the right-hand thermistor-resistor junction.

"Now, when the variable resistor is properly adjusted to equal the fixed resistor, the battery current divides equally between the left and right sides of the bridge. Since the same current flows through each thermistor, any resistance change in one is duplicated by the resistance change in the other, and the bridge stays in balance. Voltage drop along the two sides is identical, and no current flows through the meter."

"How do you know the thermistors in your bridge are matched?"



"Because I matched 'em. I put the bridge in the freezer where the temperature is below zero and then put it in that light-bulb-heated oven and brought the temperature up to 150 degrees. I kept repeating this test with different combinations of thermistors until I found two that would go through the temperature swing with practically no indication of current through the meter at any point. You satisfied?"

"Yep, but how does the thing measure wind velocity?"

"As you can see, one thermistor is mounted inside this aluminum can with tiny holes in the top and bottom to permit outside air to filter very slowly through. The other thermistor is mounted out in the open so wind can blow around it freely. When battery current flows through both thermistors, heating them, the heat is lost to the surrounding air. In a dead calm, the heat lost by the enclosed thermistor and the heat lost by the one outside in absolutely still air will be the same and no reading will show on the meter.

"However, when a wind is blowing, the heat from the exposed thermistor will be carried away; the harder the wind blows, the faster heat is lost. Heat lost by the enclosed thermistor in its artificial calm will remain the same. The wind-cooled thermistor will stay high in resistance while its hotter buddy inside the can will go lower in resistance, unbalancing the bridge and permitting current to flow through the meter. All we have to do is to calibrate this current-indicating meter in terms of wind miles per hour and we have a remote-indicating anemometer with no moving parts."

"I suppose this little wooden umbrella-shaped canopy is to keep the sun and rain from influencing the reading."

"Right. Actually the whole thing is pretty crude, but I want to put it up for a while and see how much rain and sun does affect it. This variable March weather is ideal for making such a study. Will you put it up?"

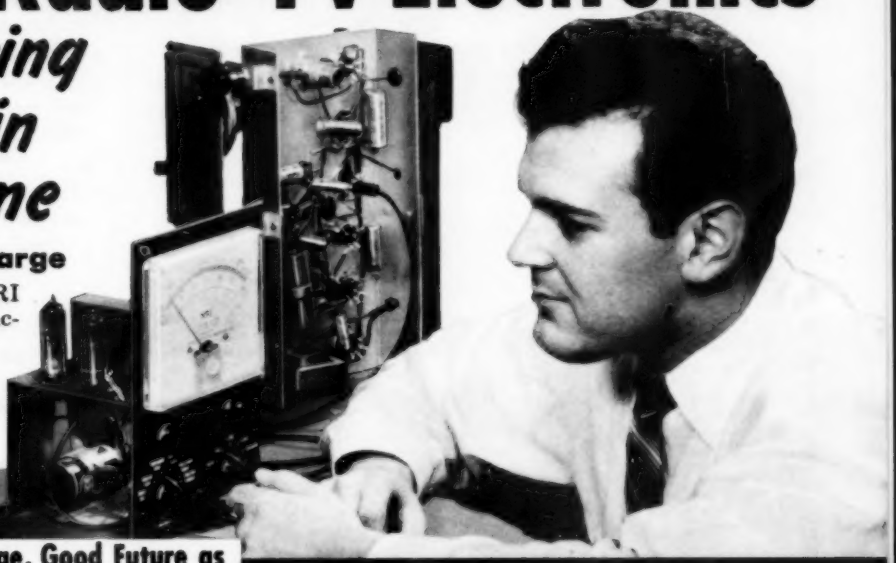
"Oh, I reckon," Carl said gruffly. "Quit stalling and get to the doctor."

ACTUALLY Carl was as eager as his friend to try out the new gadget, and he lost no time after Jerry had gone. It took but a few moments to fasten the device securely to the garage gable and to run the four-wire TV antenna rotor cable back into

(*Continued on page* 121)

Learn Radio-TV Electronics

by Practicing at Home in Spare Time



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NRI has devoted 40 years to developing simplified practical training methods. You train at home, learn by doing.

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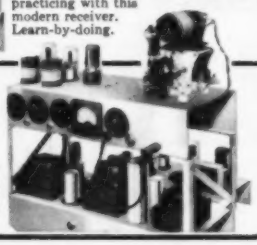

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As part of NRI Communications Course you build this low power Transmitter, learn commercial broadcasting operators' methods, procedures. Train for your FCC Commercial Operator's License.

YOU BUILD This 17 Inch Television Receiver

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YOU BUILD Vacuum Tube Voltmeter

Use it to earn extra cash fixing neighbors' sets; bring to life theory you learn from NRI's easy-to-understand texts.

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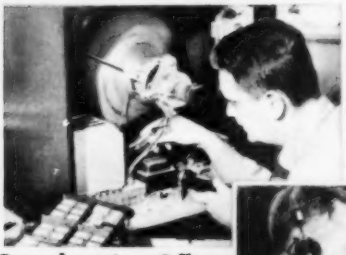

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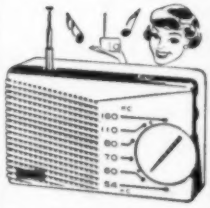

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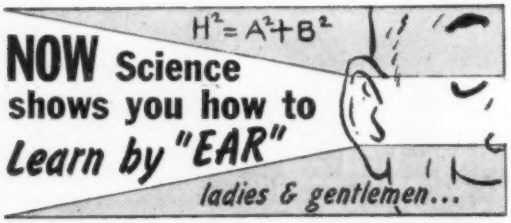

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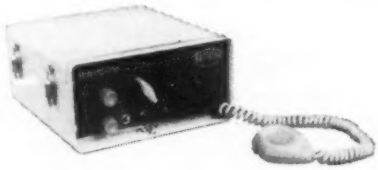
Citizens Band Transceivers

(Continued from page 104)

RAYTHEON MANUFACTURING CO.
100 River St., Waltham, Mass.

Model "RAYCOM"

Five-channel transceiver; operates from 12 or 32 volts d.c. or 117 volts a.c.; designed primarily for marine installa-



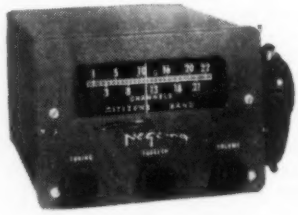
tions; adaptable for other applications; superhet receiver has automatic noise limiter.

RAYCOM $179.50

REGENCY (Div. I.D.E.A., Inc.)
7900 Pendleton Pike, Indianapolis 26, Ind.

Model CB-27

Two-channel 4-tube transmitter coupled to 11-tube dual-conversion superhet receiver tunable over entire band; has



adjustable squelch, automatic noise limiter, pi-network antenna system; sensitivity 2 microvolts or better.

CB-27 (117 volts a.c.).....$124.95
CBM-27 (12 volts d.c.).....$124.95

SHELL ELECTRONICS MFG. CORP.
112 State St., Westbury, L. I., N. Y.

Model CB-12

Single-channel crystal-controlled transmitter; tunable superregenerative receiver; available in models for 117

volts a.c. and 12 volts d.c. or for 117 volts a.c. and 6 volts d.c.; 11½" x 4⅜" x 6¼".

CB-12 .....$79.95

TECRAFT SALES CORPORATION
Box 116, River Edge, N. J.

"Falcon" Model

Three transmitting channels coupled with 9-tube dual-conversion tunable receiver; pi-network output tuning permits matching any antenna; adjustable squelch, automatic volume control, series gate noise limiter; universal power

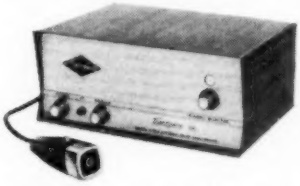
supply permits operation from all voltages; 13" wide, 4⅝" high, 9⅝" deep.

"Falcon" *$144.95*

TRANSPACE INC.
12902 Foothill Blvd., San Fernando, Calif.

Model C-27A

Six crystal-controlled channels for transmit and receive;



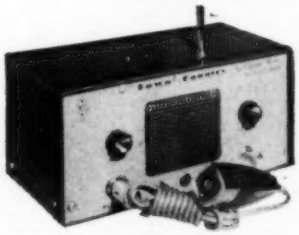
superhet receiver with automatic noise limiter, adjustable squelch, 3 watts output.

C-27A (6 volts d.c. and 117 volts a.c.).....*$169.50*
C-27A (12 volts d.c. and 117 volts a.c.).....*$169.50*

UTICA COMMUNICATIONS CORP.
19 S. La Salle St., Chicago 3, Ill.

Model PT27 Town & Country

Single-channel unit with 12-tube receiver and two-tube transmitter; adjacent channel attenuation down 500 times;



power supply isolated from other stages to insure low noise level; adjustable squelch; operates from all voltages.

PT27 ..... *$159.50*

VOCALINE COMPANY OF AMERICA, INC.
Old Saybrook, Conn.

Model ED-27 Commaire

Fixed-channel 8-tube dual-conversion superhet receiver with 0.1-microvolt sensitivity and high selectivity (± 5 kc.

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at points 6 db down); 4-tube single-channel transmitter with high-level modulation; transistorized power supply; adjustable squelch circuit; 5¼" high, 9¼" wide, 8¼" deep; 11 lb.; operates on 117 volts a.c. and 6 volts d.c. or 117 volts a.c. and 12 volts d.c.

Commaire ED-27 ..... *$179.50*

WIGHTMAN ELECTRONIC ENGINEERING CO.
Easton, Md.

Model WE-PT1 *(photo below)*

Single-channel transmitter and receiver; crystal-controlled transistorized superhet receiver with r.f. stage and two i.f. stages; crystal-controlled transistorized transmitter with 100 milliwatts input to the oscillator; powered by eight self-contained 1½-volt batteries; 9¾" x 3½" x 2¾"; 2¼ lb.; includes speaker-microphone and built-in antenna.

WE-PT1 ..... *$149.50*

WORLD RADIO LABORATORIES
3415 W. Broadway, Council Bluffs, Iowa

Model ECBK Kit

Single-channel crystal-controlled transmitter; tunable super-

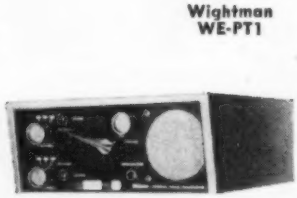
regen receiver with r.f. stage; operates on 117 volts a.c. or 6 or 12 volts d.c. (with separate power supply).

ECBK Kit *$39.95*

Ray Jefferson 905

Wightman WE-PT1

See pages 103-104 for specifications



Philmore TC-11

Maxwell 27C

-30-

Carl and Jerry

(*Continued from page* 114)

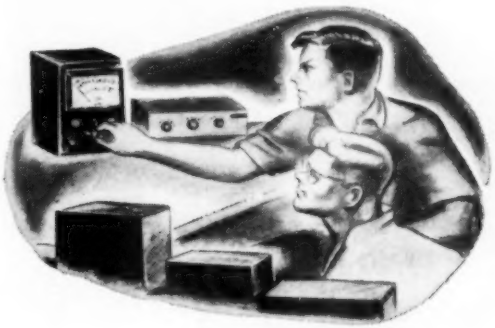
the basement through a casement window. There he connected two of the wires to the battery-and-switch combination, and the other two were connected to the milliammeter. When the switch was thrown, the meter indicated up-scale; and Carl was fascinated by the way the meter reading kept step with the roar of the March wind outside. He was still watching the meter when Jerry came in the door.

"You're still kind of fat in the face," Carl remarked critically, "but you look better. Could he save the tooth?"

"He can if he wants to; I left it with him," Jerry replied breezily. "He yanked it out, and it didn't hurt a bit."

"Just wait until that dope starts dying out," Carl said with the voice of experience. "Your gadget is working fine, Jer. Watch how the meter pointer moves up every time the wind bends the tops of those trees through the window there—hey, that's funny," he broke off. "It was working swell, but look at the crazy way it's behaving now."

The meter was acting strangely. No longer did the pointer keep step with the roar of the wind. First it bobbed up and down the scale erratically and then began backing off scale below zero. Finally it settled firmly against the left-hand stop



and refused to budge until Carl opened the switch; then it came to rest on zero.

"Something's gone wrong out there. You stay here and watch the meter while I go have a look," Carl suggested.

He had hardly reached the top of the outside basement stairs when he began shouting: "Call the fire department! Call

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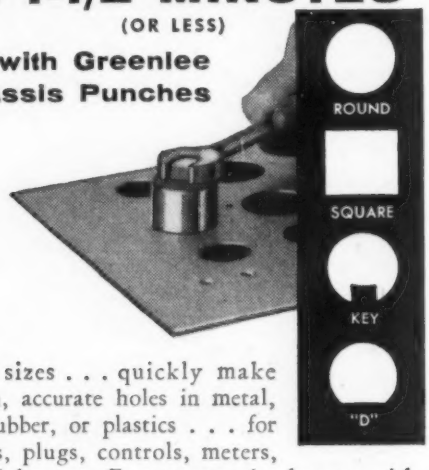

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KIT $39.95 WIRED $59.95

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GROVE ELECTRONIC MFG. CO.
4103 W. BELMONT CHICAGO, ILL.

the fire department! Kreuger's barn across the alley is on fire, and is it ever going!"

Jerry rushed upstairs and called the fire department, and then he ran out in the back yard. By this time the old two-story frame barn across the alley was a mass of flames; and blazing shingles were sailing all around. Long tongues of flame reached across and licked at Jerry's garage.

The fire department came roaring up and started playing water on the burning barn and the other buildings nearby, but the fire was not put under control until it had burned the high tension wires overhead in two.

"Boys, that was close," the fire chief said to Carl and Jerry. "If the thing had had ten minutes more start with this wind, that whole row of garages could easily have

gone. It certainly is a good thing you spotted it when you did. How did you happen to see it?"

"Well, we were kind of tipped off by a sort of fire detector we had installed on our garage roof," Jerry explained lamely. He knew from bitter experience the difficulty of trying to describe the working of electronic equipment to people without an electronic background.

"Actually it's not hard to figure what happened," he said to Carl after the chief had gone and the two boys were walking back to their laboratory. "The wind was blowing right from the fire toward our garage. When a tongue of flame would lick over and slu-u-urp that exposed thermistor, the can would protect the enclosed thermistor from the quick increase in temperature. As a result, the exposed thermistor got hotter than the enclosed one, and this made the meter read backward."

"JER, old buddy," Carl said as he laid an affectionate arm across his friend's shoulders, "the thing I like about you as an

inventor is that you always invent *something*. Of course, you may set out to invent a thermistor anemometer and end up with a jim-dandy fire detector; but, by golly, you come up with something! Man, you're the most!"

"Thanks, pal—I think!" Jerry answered as he grinned crookedly up with his still swollen face at his friend. —30—

Portable Utility Amplifier

(*Continued from page* 85)

input jacks. Set gain control *R1* for the desired volume level and switch *S1* to the high or low impedance settings depending on the unit being tested. If in doubt, try *S1* in both positions.

To test speakers or low-impedance headphones, simply plug them into jack *J5* and flip output impedance switch *S3* to 4 or 8 ohms. High-impedance headphones can be tested but will give low volume.

Many other applications are possible for this versatile instrument. For example, it will serve as a low-power p.a. amplifier, a guitar amplifier, or as a booster for low-volume transistor portables. And it won't be hard to find dozens of other uses. —30—

HOW IT WORKS

Audio signals applied to one of the four input jacks (*J1* to *J4*) are coupled through input switch *S1* to *Gain* control *R1*. The input circuit normally has a low impedance, but it can be changed to a high input impedance by switching resistor *R3* in series with the *Gain* control. Input signals are applied to the base of preamp stage *Q1*. Stabilized base bias is furnished *Q1* by voltage-divider *R2-R4* in conjunction with emitter resistor *R5*, bypassed by *C2*. Resistor *R6* serves as the collector load, with stage decoupling provided by *R7* and *C3*.

The amplified signal developed across *R6* is coupled through *C4* to the driver stage, *Q2*, with the primary winding of driver transformer *T1* serving as *Q2*'s collector load. Transformer *T1* has a dual job: it matches *Q2*'s moderate output impedance to the relatively low input impedance of the push-pull stage and supplies the out-of-phase signals needed to drive the push-pull power amplifier, *Q3-Q4*.

The small base bias required by the output stage for class AB operation is furnished by the d.c. drop across *R13*, stabilized by unbypassed emitter resistors *R14* and *R15*. The power amplifier stage is coupled to its load through impedance-matching transformer *T2*. A negative feedback signal is obtained from *T2's* secondary and coupled back through blocking capacitor *C5* and *Tone* control *R11* to *Q2*'s collector.

Output transformer *T2* has a tapped secondary to provide a choice of output impedance values. The signal delivered here is coupled through the speaker impedance switch *S3* and closed-circuit output jack *J5* to the loudspeaker's voice coil. When a plug is inserted in *J5*, the speaker circuit is opened and the output signal can be delivered to an external load.

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TRANSISTOR RADIO KIT

Includes black and gold portable case, extra sensitive transistor and diode, variable capacitor for tuning, "loopstick" for sensitivity, pre-punched chassis board. Complete with earphone, battery and all parts. Simple, illustrated instructions. Shp. wt.: 3½ lbs.

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MODEL VP $11.73 Net

"THE TWIN" RADIO KIT

Kit includes pre-punched chassis board, loopstick, capacitor, matched transistors and diode, tuning dial, advanced circuit, portable plastic case with gold grille. Complete instructions. Phone and battery included. Can be built by anyone: no soldering. Shp. wt.: 3½ lbs.

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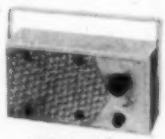
MODEL TNT $7.34 Net

TRANSISTOR PORTABLE RADIO



Features pre-punched chassis, gold plated printed circuit board, four transistors and diode, transistor loopstick, 2½" loud speaker, earphone jack. Compact and portable. Easy to build, complete illustrated instructions included. All necessary parts, complete. Shp. wt.: 3 lbs.

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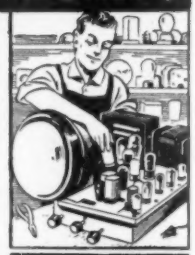

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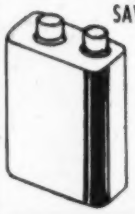

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Test Instruments

(*Continued from page* 88)

audio generator is shown in Fig. 14(A) and that of the Heathkit AG-10 sine-square generator in Fig. 14(B).

The Knight-Kit generator provides five steps of output attenuation and the Heath offers four. The somewhat more complicated Heath circuit (it's a "ladder" attenuator) results from Heath's desire to have a constant output impedance (600 ohms) on the three lower ranges.

Knight's attenuator is a straightforward voltage divider, each step down providing one-tenth the voltage of the previous step. This voltage division corresponds to steps of 20 db and the Knight-Kit's five knob positions are conveniently marked from 0 to 80 db. Zero db does not mean that there is *no* output, but rather serves as a reference point. When the attenuator is set at 0 db, the actual voltage at the output terminals depends on the setting of the *Output Level* control.

Metering. When you test an amplifier with an audio generator, there are a number of things you want to know about the outputs of the signal generator. Usually the waveshape, frequency, and amplitude are the important factors. Occasionally you'll be concerned with the output impedance of the generator, the percentage of distortion, the rise time of the square wave, etc., but basically the first three factors mentioned are the significant ones.

The waveshape and the frequency you can take more or less for granted, as they

"Of course, I don't have much in the way of equipment . . ."

will correspond to the setting of the generator's controls; but how about the amplitude of the output signal? Since the voltage output of the generator does vary somewhat with load, it would be handy to know exactly what voltage the generator is putting out. Frequency response runs and gain measurement both require a known input signal to the amplifier under test. Of course, a standard VTVM or even VOM will generally serve to measure generator output, but when you want to find out if an audio generator is putting out 5 or 8 millivolts, then either an audio VTVM has to be brought into the act *or* your generator has to have metering built in.

Although some of the more expensive laboratory audio generators have a full-fledged audio VTVM built in, such elaborate measures aren't really required. Heath uses a sensitive meter in its Model AG-9A which monitors the audio signal by tapping in after the output control (where the signal is still high enough to give a usable deflection of the meter needle) but before the attenuator. See Fig. 15.

Occasionally you'll come across generators with other features and "accessories." The more expensive units, particularly, have all sorts of special "built-in's." Before you buy a generator, it's a good idea to check the circuit and the controls so you can judge how meaningful they will be to you in your particular applications. Don't be swayed by a couple of extra knobs that will do nothing more for you than clutter up the panel of the instrument. —30—

Transistor Topics

(*Continued from page* 94)

ful for "transmitter hunts" at hamfests. He has achieved operating ranges up to one mile.

Transistor *Q1* is a *p-n-p* r.f. unit employed in the common-emitter arrangement as a crystal-controlled oscillator. Operating power is furnished by a small battery, and the signal is radiated from a short whip antenna.

Construction is straightforward and should be non-critical. Bill used a Raytheon Type 2N416 for *Q1*. A 1.5- to 2.5-mhy. (*RFC1*) choke serves as a collector load. A 9-volt transistor battery, such as a Burgess Type 2N6, may be used as a power source (*B1*); battery polarity should be re-

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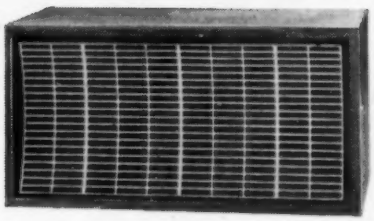

Among many individuals, there is a need to minimize on the space to be devoted to a component stereo system. A rash of "bookshelf" types have appeared in an attempt to meet this need. In practice, however, they seem neither fish nor fowl...either too large for compactly spaced bookshelves or too small for use as free-standing units.

The AUDAX CA-60 is a *true* bookshelf speaker system, measuring only 9" high by 10½" deep by 18" wide. It houses a 6" woofer and separate tweeter in a ducted-slot enclosure constructed of ¾" thick wood, finished in oiled, hand-rubbed walnut on four sides. The grille is shaped in an attractive parabolic contour, giving the unit a character which blends with a variety of surroundings.

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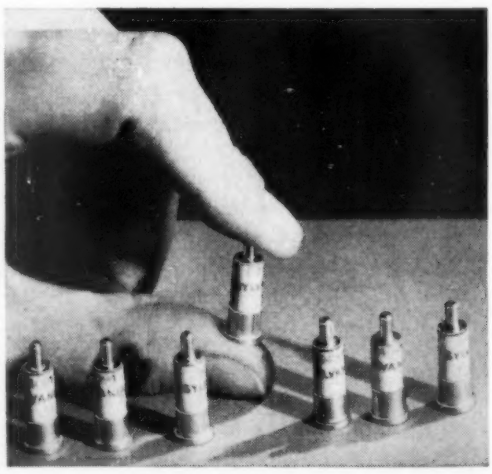
versed if an *n-p-n* transistor is used. Whip antenna length will vary somewhat with exact frequency of operation and, therefore, with crystal frequency; WV6ICY uses an 18" "whip" and a 3-mc. crystal.

In some cases, circuit operation may be improved by applying a small bias to *Q1*'s base. Do this by connecting a 1-megohm, ½-watt resistor between the base and B−. Experiment with the bias resistor value for optimum performance.

Product News. One of the nation's leading producers of semiconductor devices, the International Rectifier Corporation (1521 East Grand Ave., El Segundo, Calif.), has introduced a low-cost 100-ampere silicon rectifier assembly designed for battery charger applications. Assembled on a flat metal heat sink equipped with mounting holes, the unit consists of two silicon junctions incorporating successive layers of humidity-resistant insulating resins and sealants, assuring optimum operation over a temperature range from −20 to +130°C. Detailed technical data is given in Bulletin SR-210, available on request from the manufacturer.

New buses now being produced by GMC's Truck and Coach Division are equipped with a fluorescent lighting system which provides 12,000 lumens with a total power consumption of only 400 watts, compared to the old-style incandescent system which supplied only 7000 lumens while requiring 620 watts. A 13½-pound transistorized inverter converts the bus d.c. power into the a.c. required for fluorescent lamp operation. Five tubes serve to replace 28 lamp bulbs



Microwave mixer diodes are being made by Sylvania Electric Products for frequencies up to 1500 mc.

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- ✔ *What sort of standing waves do I get in my listening room?*
- ✔ *Are my speakers hooked up correctly? Are they phased properly, and is the correct speaker connected to the right stereo channel?*
- ✔ *How perfectly is my system equalized?*
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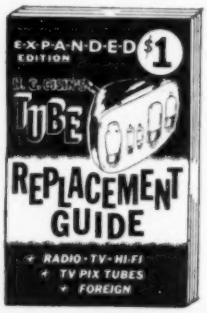

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in a large bus, with each tube having a life expectancy 15 times greater than that of regular lamps.

Sylvania Electric Products, Inc. (730 Third Ave., New York 17, N. Y.) has announced a new silicon microwave diode designed for microwave mixer applications at frequencies up to 1500 mc. A point-contact type, the unit has a conversion loss of only 5.5 db and is expected to improve the performance and effective range of radar and missile tracking systems in which it is used.

Tunnel diodes are available as experimental samples from both G.E. and RCA. Current prices are quite high, since units are virtually handmade, but prices are expected to drop as soon as production problems are ironed out and one or more regular production lines are started.

The "Cine-Voice" 16-mm. motion picture camera produced by the Television Specialty Company, Inc. (350 West 31st St., New York 1, N. Y.) is now equipped with a built-in transistorized amplifier, permitting "one-man" handling of sound-on-film shooting assignments.

And that's the story for this month.

Lou

Add a Tuning Meter

(*Continued from page* 54)

clear, then deflects down as the station is detuned. Between stations, the meter pointer will be at zero.

In tuning, you should always have the a.f.c. switch set at "off." When the tuning meter indicates correct tuning, switch the a.f.c. on to "lock in" the station.

Adapting Other Tuners. Wiring other tuners for operation with a tuning meter should be equally as simple. The vast majority of tuners use either a ratio detector (like the FM-4) or a Foster-Seeley detector, both of which are easily adaptable for meter operation. See Fig. 3.

The only component which is required other than the meter is a resistor to limit the amount of current through the meter. The value of this resistor should be low enough to allow the meter to deflect ¾ of its scale. Start off with about 300,000 ohms and work your way down until the desired amount of deflection is obtained. Excessive needle swing should be avoided since the meter could be damaged by excessive current. —30—

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Communications Satellites

(*Continued from page* 44)

minorities—Greek drama, chess matches, lectures in differential calculus.

Asia and Africa have been flooded with inexpensive TV receivers, and Russian and U. S. satellites are engaged in a fierce ideological battle for uncommitted minds. (Long before the year 2000, the struggle to determine whether English or Russian becomes the world's dominant language will have been won or lost on this electronic battlefield.)

Mail is delivered anywhere on earth in less than a day. We write our letters on a special form. At the post office, the words are transformed into electronic signals which are transmitted via the mail satellite relay within a few millionths of a second. A high-speed printer on the other end turns the signals back into words, and the letter is delivered. The only delay is in getting it to and from the post office.

By 1980, the changes will be even more dramatic. Newspapers will be produced on demand in the home. All you will have to do is flip a switch on your facsimile printer and out will roll the sports page, the funnies, the news section, or any combination you select. You will have your own personal radio-telephone and you will be able to call any place on earth at a moment's notice. Most business conducted by personal contact back in 1960 will be handled over the video and facsimile channels in 1980. Of course, your telephone will have already been equipped with a TV screen for many years.

These wonders will begin to appear far earlier than most of us think. *Every one of the devices described above is already in use. Not one new invention or development will be needed to put any part of this system into operation.*

Businesses all over the country, for example, now have their own facsimile systems which transmit letters, pictures, and plans instantaneously from one plant or office to another. Miniature radios which could be used in a world-wide paging system have already been built. Complete engineering plans and specifications have been drawn up for an intercontinental mail system using equipment which is already available.

The only new ingredient we need to make all of these miracles available is long-

distance satellite communications—and we will have it soon.

Profound Significance. The impact of global radio and TV will be profound. It will mean not merely bigger and better entertainment, but it will change our civilization. Arthur C. Clarke—the internationally recognized space expert—summed it up this way in an article in the September 1959 issue of Holiday magazine:

"Soon, the great highway of the ether will be thrown open to the whole world, and all men will become neighbors, whether they like it or not. Any form of censorship, political or otherwise, would be impossible; to jam signals coming down from the heavens is almost as difficult as blocking the light from the stars. The Russians could do nothing to stop their people from seeing how Americans live; on the other hand, Madison Avenue and blue-nose committees might be equally distressed—though for different reasons—at a nationwide switch to uninhibited telecasts from Montmartre.

"No one can ever anticipate the full significance of any major invention; did Henry Ford dream that the very foundation of commerce, warfare, entertainment—yes, and morality—would be shaken by the automobile? And what radio and TV have done to our lives in the last decade merely hints at the revolution *real* telecommunications will bring 20 or 30 years from now.

"How mankind will cope with the avalanche of information and entertainment about to descend upon it from the skies, only the future can show."

One thing is sure, the sciences of rocketry and electronics have launched the human race into the age of space communications, and there's no turning back! —30—

Across the Ham Bands

(*Continued from page* 97)

unwind ½-turn from each end of the remaining coil, leaving a 6½-turn coil for *L2*. Keep the coil insulation intact to hold *L1* and *L2* together.

Solder the lead from *L2* closest to *L1* to the rotor terminal of *C1* and the opposite lead to the stator of *C1*. Connect *L1* to a two-terminal connector mounted on the bottom of the can using a pair of flexible, insulated wires about six inches long. Now connect a similar wire between *C6* and the

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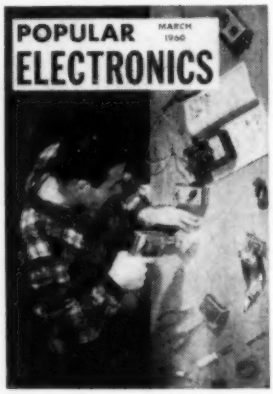

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News and Views

Lou, HH2LD, President of the Radio Club d'Haiti, P. O. Box 943, Port au Prince, Haiti, asked me to tell you about the HH-20 Diploma awarded by the club to any ham working 20 HH (Haitian) hams since January 1, 1950. QSL cards are not required. Just send a list of your contacts to the above address with $1.00, and Lou will do the rest; but you must have the secretary of your radio club *certify* your list. A sticker will be issued for each additional ten HH's worked. Three U.S. hams —W3AYD, K9AMD (the first YL to earn it) and W9EGQ—have received the certificate to date. And if W9EGQ can work 20 HH's, so can you. As it is written in French, I am not sure exactly what mine says, but it sure looks impressive on the wall.

"Where are the sevens?" asks **Neil S. Mishaloff, WV2HVR/WA2HVR** (16), 1294 Diane Drive, Seaford, L. I., N. Y. In three months on the air, Neil's Heathkit DX-40, Hallicrafters SX-99, and a 40-meter folded dipole antenna have accounted for 37 states (34 confirmed) and seven foreign countries—but he has not worked a single W/K/KN7 yet. He manages to console himself with KC4USB, Antarctica, OK1EB, Czechoslovakia, and the like. . . . . **Bill Suess, KN8QXF,** 14522 Supena Rd., Cleveland Hts, Ohio, keeps his Heathkit DX-20 mostly on 40 meters, with an occasional visit to 15 meters. His record after two months on the air is 225 contacts in 20 states. His "hearing aid" is a Hallicrafters SX-110. . . . . **Gene Mitchell, K3DSM,** 352 Woodley Rd., Merion Sta., Pa., works all bands, 80 through 2 meters and has 34 states and five countries worked. He uses a SX-99 receiver, plus an International FCV-1 converter for six meters. He transmits on a Heathkit Cheyenne and a home-built 20-watter.

Dick Wall, K6JMK (12), 628 Santa Barbara Ave., Millbrae, Calif., recently knocked the "N" out of his call and built a screen modulator for his DX-20. In five weeks, he has worked 25 states, including quite a few on the east coast. Dick receives with a Hammarlund HQ-100. . . . . **Ken Spears, K5VYL** (17), 3102 Garland, Texarkana, Ark., racked up 32 states and Cuba in two months as a Novice, mostly on 40 and 15 meters using a Globe Chief 90A transmitter and a National NC-300 receiver. Ken will sked anyone needing Arkansas, and will help prospective hams get their licenses. . . . . **Tom Morgali, KN7IUF,** Moneta, Wyoming, runs 75 watts to a DX-40 transmitter, and he receives on a National NC-188. His record is 22 states worked, all confirmed.

Robert "Cactus" Gay, K4YMB (19), 402 College Ave., Scottsboro, Ala., uses a DX-40 transmitter with a plate modulator on 40 and 75 meters, and a DX-35 on 15 and 10 meters. He uses a Heathkit VF-1 VFO to control the frequency of either transmitter by throwing a switch that actuates a relay to connect the VFO to the desired one. Cactus has two receivers, a Hallicrafters S-53A equipped with a Heathkit Q-Multiplier, and an S-38D with an extra i.f. stage for increased sensitivity and selectivity. He has worked 42 states, mostly on phone. . . . . **Rodger Skinner, KN3JMP,** 1205 Atlantic Ave., Monaca, Pa., runs 50 watts to a Johnson Adventurer transmitter feeding a 40-meter dipole about 17′ high. He receives on a Hallicrafters S-107. Rodger is another member of the where-are-the-sevens club—he has worked 35 states, Canada, and Australia, but he still is looking for his first seven. (See photos of K4YMB and KN3JMP on page 96.)

Martell Bolden, KØSAJ, 1110 W. 12th St., Des Moines, Iowa, built and used the 15-meter beam described in the May 1959 POPULAR ELECTRONICS (page 116) and found it worked swell when he was a Novice. He didn't try the phone band for some time after getting his General, but he now reports that it is equally good on phone, giving him 35 to 40 db over S9 reports with his WRL Globe Scout, running 50 watts. The beam cost him $4.00 to build. The rotator cost $16.00. Martell suggests varnishing the cane poles with boat varnish for long life.

Ed Franklin, KN9UBK, 1600 George St., Logansport, Ind., has worked 28 states in 31 days on 80 and 40 meters using a 75-watt, homebuilt transmitter lent to him by K9AYF and an S-107 receiver. Ed does most of his operating around 3:00 a.m. on weekends. . . . . **John Garcia, K6VLC,** Hq. Bat., 19th Arty., Fort Ord, Calif., just passed his General exam. With his Johnson Challenger transmitter feeding a dipole 40′ high, and a Hallicrafters SX-99 receiver, his record as a Novice is 45 states and 66 countries, all confirmed. He hopes to do better when he gets out of the Army. . . . . **Wayne Gregory, Jr., KN7SYQ,** 7722 1A N.E., Seattle 15, Wash., offers himself as proof that there *are* hams in the seventh call area. He has a Heathkit AR-3 receiver and an old Hallicrafters HT-17 transmitter.

That uses up our space until next month. As always, I would like to hear *your* news and views, and see *your* construction projects. 73,

Herb, W9EGQ

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On the Citizens Band

By **TOM KNEITEL,** 2W1965

CITIZENS BAND organizations, or clubs, are generating considerable interest throughout the country, so this month we'll give you a thumbnail sketch of what's happening in one of the many local groups. It's the one that I belong to, but it could just as well be any CB club in any city.

New York, as you may know, is more than just *a* city: it consists of five associated boroughs, or sections, in each of which there are local CB clubs. Most of the members of these organizations also belong to the United Citizens Banders, Inc. (Class D), a national organization located at 79 Garden St., Hoboken, N. J.

Our local group, in the Queens section of the city, is called "The Five-Watt Wizards." We get together every few weeks for a gabfest about CB problems, both on a local and national basis. We've made arrangements with a number of electronic stores for member discounts, and our club newspaper lists equipment for sale by members. A very useful service has been the "relay" system, whereby members' base stations stand watch on assigned frequencies during specified periods to aid mobile stations in getting through to their own out-of-range base stations.

We have set up our own self-policing network, and our monitors are constantly sending reports of illegal and improper CB operation to monitoring headquarters, run by Al Schabhuttl, 2W2297. Al compiles and studies the various reports and then decides what action should be taken—either to make a telephone call to the erring operator, or to run him down with direction-finding equipment and report him to the FCC. "The 5WW's" have already been responsible for FCC action against a number of unlicensed and illegally operated CB stations, and our work has been written up in local newspapers.

Our dues are low and go mainly for paying the tab for a meeting hall and for coffee. Members have contributed their

own services in providing letterheads and other office supplies. Like many others, our club is helping to build an organized and orderly Citizens Band.

We got a look at the Polycomm II a few weeks ago and we're happy to report that if you need a rig that can take a beating, this is for you. "Solid" isn't the word for it—it's like an armored truck with tubes and crystals. It's the only unit we've come across that has no relay in the transmit-to-receive switching circuit, and the familiar push-to-talk "click" is conspicuous by its absence. There's a nice series-gate noise limiter which can be switched on and off—good for mobile installations. And it's got four transmit-receive channels.

FLASH!

Just before press time we attended a big pow-wow of CB equipment manufacturers which took place at the National Motor Boat Show at the Coliseum in New York City. The purpose of the meeting was to select and suggest, on an unofficial basis, various CB channels for marine use.

It was decided that Channel 9 be utilized as the "Commercial (coastal) Working Channel," the "Non-Commercial (inland) Calling Channel," and the "Secondary Non-Commercial Channel." Channel 13 will do the honors as the "Primary Non-Commercial Channel."

This ties in roughly with Ron Cohen's suggestion for a "national CB calling and emergency channel" which we mentioned here a few months ago. We'd like to see Channel 9 used as a calling frequency for all stations, whether they be base stations or mobile units. Contact would be made on 9 and then the stations would switch to another channel to handle the message (leaving 9 clear).

We'll go into this whole subject a little more deeply in the next issue—just thought you'd like to see an honest-to-goodness news-flash-type scoop from your CB Editor.

Your help is requested with a little private survey we're conducting. Please drop us a post card and let us know the channel numbers of the busiest "personal communications" CB frequencies in your call area.

Numerous potential commercial users would like to avoid these channels like the plague, and certainly "personal" users won't have any objections to this idea. When we have the survey completed, we'll run it here for your information. —30—

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Understanding Ham Lingo

(*Continued from page* 89)

The ham who calls "CQ" is looking for a contact with any station that cares to answer. A "CQ DX" call indicates that he wants distant stations only to answer.

A "QRM" or "QR Mary" is interference caused by other stations, and "QRN" is interference caused by atmospherics or electrical disturbances in the ether. The latter is usually called "QR Nancy." A ham in South Africa might never know why you weren't copying him if you didn't use a phonetic to distinguish between QRM and QRN. When the northern lights are at their peak, operation is almost impossible. (There is a name for the Aurora Borealis which is never used on the air.)

A signal with "QSB" is an unsteady or fading signal. Many amateur operators call it "QS Baker."

The "Q" signals are used by Morse code operators to save time. All amateur operators must know the code in order to get through the FCC exams. When an amateur states that he came up from the "c.w." band, he means that he moved up from the continuous-wave or Morse code section of the radio spectrum. "QRX" originally meant to move up or down the frequency a little to a clear spot, but has now also come to mean "please stand by."

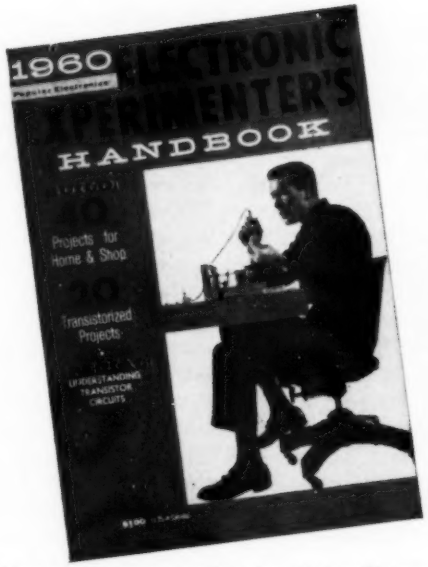
A "QRT" means that you are going to stop transmitting, and a "QSL" is a special post card acknowledgment of a contact. A "QSO" is a contact. And a "pipeline" QSO is a very clear, static-free conversation; when you make one of these, you are said to be "burning a hole through it."

Another expression indicating pleasurable listening is "armchair copy." And when one ham desires to meet another ham in person, he wants an "eyeball QSO."

A contact that lasts an hour or more becomes a "rag-chew." Any amateur is eligible for a rag-chewer's certificate to hang on his wall provided that he is recommended by another amateur who is a member of the "Rag-Chewer's Club."

A ham's children are called "junior operators" or, sometimes, "harmonics." The word "hi," or "hihi" is used in lieu of laughter; it had its origin with Morse Code operators who found this the best way to laugh in code.

And so it goes, OM. BCNU on the band one of these clear nights. —30—



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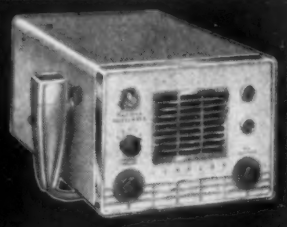

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(*Continued from page* 52)

transfer, and cycles the resulting steam through a turbine. The turbine rotates and turns the armature of an electric generator. And the electricity produced by the generator follows the normal paths of power distribution until it eventually ends up powering your television set or electric egg-beater.

Super-Furnace? Now a question arises: isn't this whole nuclear reactor thing really a sort of super-furnace?

Well, yes. That's very much what it is. And when a nuclear reactor is used to drive a submarine, it's still much the same type of thing.

But isn't that something like basing all of electronics on a power supply fed by lightning rods? Right. There is no such thing today as a true atomic power supply. What we have are furnaces that "burn" radioactive material in much the same way other furnaces burn coal and oil. They produce heat which we handle with the same techniques that were established when steam power was the bright promise of tomorrow.

In order to convert atomic energy into heat, we refine radioactive materials, package them in precise ways, coax them into producing controlled nuclear reactions, and then we harness the heat produced by these reactions. And we're pretty good at doing this, considering the state of the art. But the art is not very economical.

Cost Comparison. When the pioneering reactor at Shippingport, Pa., went into operation, it produced electricity at a cost of five and a half cents for ten kilowatt hours. The same amount of electricity can be produced by a competing coal-fired generating plant for half a cent. Granted, Pennsylvania is a state with anthracite to burn, but the Atomic Energy Commission's figures indicate that by 1980—the year the AEC expects nuclear-generated electricity to equal today's conventional power output—the proportion of conventional generating plants to nuclear ones will be greater than it is today. The fact is that we have many more efficient ways of producing and harnessing heat than by nuclear fission.

In England, where the local coal supply is nearly exhausted, reactor-generated electricity is just barely able to compete with conventional power. Nor is any other

country in the world doing any better. Poland, for example, has a new—presumably Russian-designed—reactor, resembling England's Calder Hall type, which can be tapped for power. But although the prototype Calder Hall design has many good features, it is one of the earlier, less efficient, types of reactors.

In general, Russia and her side of the fence seem to be a little behind ours when it comes to peaceful uses of atomic energy. Nobody, but nobody, has "atomic power." What a lot of people have is superheated steam which happens to have been produced by neutrons bouncing around inside a reactor rather than burning coal or oil.

Atomic "Kites." Why, then, are we spending so much money on atomic power plants when they are clearly inefficient and uneconomical? Every ingenious method of getting *around* some reactor-operation limitation is actually an admission that we don't know the way *through;* we don't know how to tap the atomic energy directly. We only know a rather clumsy way to drain off the energies resulting from the clash of atoms upon each other.

Reactors are the Ben Franklin kites of the true "atomics" that is to be. We have to fly these "kites"—as expensive as they are—because the only way we can learn about reactors is by building and using them. All nuclear reactors everywhere, no matter how they are used, are part of a vast research program. And no research program operates at a profit.

Looking at it another way, the basic atomic reactor today is like a cage holding a powerful animal we've brought back from a strange country. We build the cage as stoutly as we can and pad the walls to keep the animal from crashing out or injuring itself. We insert interior bars to restrict its movements to the path we want. We connect an eccentric arm to the movable cage floor which the animal rocks as it paces back and forth. The animal moves, the floor moves, the arm moves, a shaft turns—and we've got power. It's clumsy and inefficient, but it's the best we can do—so far.

Right now, you might say, we're designing some pretty ingenious cages. But we will really enter the age of atomic power when we get the animal out of its cage and put its shoulders directly to the wheels of industry. How? Only time and research will tell. —30—

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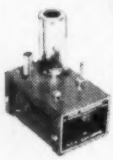

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Short-Wave Report

(*Continued from page* 66)

George manages to log the real tough stations. I asked him the same question a few years ago when he visited me. He replied by sitting in front of my receiver and proving that I, too, could hear some of those stations if I would take the time and patience to dig them out. And in those two words—*time* and *patience*—lies the secret to a good portion of his outstanding success.

Club Notes. The Universal Radio DX Club has moved its headquarters to 109 Mesa Street, Vallejo, Calif. Nineteen bulletins a year are still being issued covering the short-wave broadcast and ham bands, and yearly dues are $4.00.

The DX Shortwave Club is currently putting out an interesting bi-monthly bulletin which basically covers the short-wave bands but includes some news on other bands, including FM and TV, and articles for the amateur operator. For complete information on this club, which is now 1½ years old, you should write to Paul Pormen, Jr., WPE8ET, 5160 Mahoning Ave., Youngstown 9, Ohio.

From time to time we receive requests from various groups or individuals asking us to publicize their clubs. Quite often these clubs are only weeks (or even days) old. We prefer not to publicize any club until such time as it has a chance to "grow up" a bit. Past experience has proved that the large majority of new clubs only stay in existence a short time and then pass into oblivion.

So give your club a chance. Help it to grow slowly. When you have a sound organization, we will be pleased to mention it in this column.

Current Station Reports

The following is a resume of current reports received. At time of compilation all reports are correct. Stations often change frequency and/or schedule with little or no advance notice. All times shown are Eastern Standard and the 24-hour system is used. Please send your reports to P. O. Box 254, Haddonfield, N. J., in time to reach your Short-Wave Editor by the eighth of each month.

Afghanistan—For the past few months *R. Kabul* has been scheduled to the Far and Near East in Eng. at 1010-1030 on 11,730 kc. and to Europe in French at 1330-1400, Eng. at 1400-1430 on 7285 kc. (*WPE1HY, WPE2ACO*)

Andorra—Andorradio, 6305 kc., has an international request program on Fridays at 1630-1800 in English, Spanish, German,

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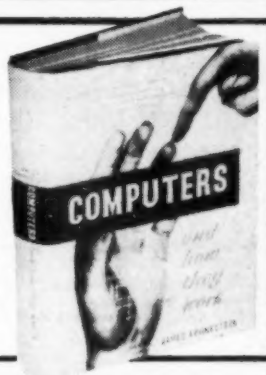

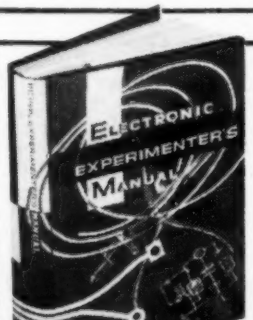

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French, and Italian, and is beamed to Northern Europe and South America. Reports go to Andorradio, Boite Postal No. 7, Andorre-La-Vieille. (*WPE1BY, WRH*)

Barbados—An interesting letter from Barbados Rediffusion Service, Ltd., Bridgetown, reads as follows: "Barbados Rediffusion Service is a wired broadcasting service covering the entire island with a network of 1200 miles of wire and serving approximately 20,000 homes with an estimated listening audience of over 130,000. Our programs originate either from our modern studios on River Road in the city of Bridgetown, or as relays from our receiving station. During special events like horse racing and cricket tournaments, our programmes are transmitted by Cable and Wireless (W.I.) Ltd. on one of the following frequencies: ZNX20, 5040 kc.; ZNX32, 7547 kc.; or ZNX49, 11,015 kc. Reports should be sent to Barbados Rediffusion Service, Ltd., River Road, Bridgetown, Barbados." (*WPE8MS*)

Bechuanaland—ZNB, Mafeking, 8230 kc., is a rarely heard station. Try for it from 0600 to 0700 (news is heard at 0610) during the Eng. period. (*CS*)

Belgian Congo—Coquilhatville has been noted on 5993 kc. from 1445 with lively instrumental and native vocals. Chimes and ID in French precede the 1500 s/off. The call is OPD2. (*WPE3NF*)

Ceylon—According to the latest schedule, the *Commercial Service of R. Ceylon* broadcasts to all Asia in Eng. daily at 2030-2330 on 15,265 kc. and at 0745-1130 on 9520 and 6004 kc., and in vernacular at 2030-2330 (Sundays to 0230) on 15,120 and 9520 kc. and at 0600-1230 (Saturdays and Sundays at 0530) on 7190 kc. An additional Eng. xmsn to S. E. Asia only is aired at 0415-0545 on 17,820 kc. (*WPE2ACO, WPE4FY, WPE5VZ, WPE8ACH*)

Germany—*R. Berlin International* (East Zone) carries Eng. at 1130-1200 on 11,765 kc., and at 1300-1330 and 1700-1730 on 6115, 7300, and 9730 kc. (*WPE8ET, WPE8MS, EC*)

The listening post of Bruce Berghamer, VE3PEIT, Ancaster, Ontario, Canada. Bruce's receivers are all homemade and cover frequencies from 1800 to 7300 kc. His antenna is 50' long and 40' high.

Guatemala—At time of compilation, there is some confusion concerning two new stations which in reality may be only one. *R. Pical*, 6253 kc., is noted ten kilocycles above its original listing of 6243 kc., and *R. Tico* is being reported on 6230 kc. The later is noted at 1940-2030 with Spanish language and L. A. and pop music and ID's every ten minutes until 2000, then on the quarter and half hour. (*WPE7BB, WPE0AE*)

India—*All-India Radio*, Delhi, carries Eng. to S.E. Asia at 0830-0930 on 21,610 kc., to Europe and W. Africa at 1445-1545 on 17,790, 15,105, 11,710, and 9590 kc.; another Eng. newscast was noted at 1930-1940 on 15,170 kc. (*WPE3FY, WPE4AIX, WPE8AFG, WPE8ET, WPE9KM*)

Iran—Teheran is using a new frequency of 7290 kc. instead of 9660 kc. It is noted at 1230 in Persian, at 1230-1330 in Kurdish, and at 1330-1415 in Arabic. Regional stations in operation include: *R. Ahwaz*, 7990 kc., 500 watts; *R. Isfahan*, 6175 kc., 500 watts; *R. Meshed*, 6870 kc., 500 watts; *R. Resht*, 7940 kc., 500 watts; *R. Rizaiyeh*, 6850 kc., 500 watts; *R. Sananadaj*, 6715 kc., 500 watts; *R. Shiraz*, 6385 kc., 500 watts; *R. Tabriz*, 6152 kc., 7500 watts; and *R. Mahabad*, on 6851 kc., with 500 watts. (*WRH*)

Iraq—*R. Baghdad* can be heard well in Eng. from 1500 to 1530 (news at 1515) and at 1530 in Arabic on 6030 kc. (*WPE1AGM*)

Israel—Tel Aviv is noted at 1430-1500 in French, at 1500-1530 in Hebrew, and from 1530 to 1600 s/off in Eng. on a new frequency of 9726 kc. in addition to the usual 9009-kc. channel. (*WPE1BY, WPE1HY, WPE2ACO, WPE3NF, WPE8MS*)

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	L.A.—Latin America
BBC—British B/C Corp.	N.A.—North America
Eng.—English	R.—Radio
ID—Identification	s/off—Sign-off
IS—Interval signal	s/on——Sign-on
kc.—Kilocycles	xmsn—Transmission

Italy—Rome operates to Eastern N. A. at 1930-1950 and to the West Coast at 2205-2225 in Eng. on 11,900 and 15,400 kc. In the latter period, 15,400 kc. may be replaced by 9575 kc. The first segment is followed by French to Canadians to 2010. Reports go to: The Italian Broadcasting & Television System, P. O. Box 320, Rome. (*WPE2BSW, WPE2BTX, WPE4HO, WPE9AOP*)

Japan—Here is the new complete schedule for *R. Japan:* to S. Asia in Hindi, Eng., Urdu, and Japanese at 1000-1130 on 11,965 and 9525 kc.; to Mid-East areas in Arabic, French, Eng., and Japanese at 1145-1345 on 11,705, 9675, and 15,325 kc.; to Europe (II) in Russian, German, French, Italian, Eng., and Japanese at 1400-1600 on 11,705, 9675, and 15,325 kc.; to N. A. in Eng. and Japanese at 1930-2030 and to Latin America (I) in Spanish and Japanese at 2200-2300 on 17,855 and 15,325 kc.; to N. A. and Hawaii in Eng. and Japanese at 0000-0200 on 11,705, 9525, and 15,235 kc.; to Europe (I) in Eng. and Japanese at 0230-0330 on 17,855 and 21,620 kc.; to Latin America (II) in Portuguese, Japanese, and English at 0400-0530 on 11,705 and 9525 kc.; to Australia and New Zealand in Eng. and Japanese at 0930-1030 on 11,940 and 15,235 kc.; to the

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POPULAR ELECTRONICS
Advertiser's Index
MARCH 1960

ADVERTISER	PAGE
Airex Radio Corporation	118
Alco Electronic Products Inc.	124
Allied Radio	21, 32
Audax—Div. of Rek-O-Kut	125
Audiotex Mfg. Co.	34
Bailey Technical Schools	24
Blonder-Tongue Laboratories, Inc.	131
Burstein-Applebee Co.	126
Capitol Radio Engineering Institute	107
Career Institute	136
Central Technical Institute	124
Century Electronics Co., Inc.	36, 37
Chicago Standard Transformer Corporation	20
Christy Trades School	124
Cisin, H. G.	128
Cleveland Institute of Electronics	15
Coyne Electrical School	13, 121
DeVry Technical Institute	7
EICO	38, 40
Electro-Voice Inc.	23
Electronic Experimenter's Handbook	137
Electronics World Stereo Disc	127
Garfield Co., Inc., Oliver	20
Grantham School of Electronics	17
Greenlee Tool Co.	122
Grove Electronic Mfg. Co.	122
Heath Company	108, 109, 110, 111, 112, 113
Hy-Gain Antenna Products	135
Indiana Technical College	132
Instructograph Company	128
International Crystal Mfg. Co., Inc.	5
Jensen Industries, Inc.	139
Jesse Jones Box Corp.	138
Johnson Company, E. F.	138
Kelsey Presses	128
Key Electronics Co.	132
Kuhn Electronics	140
Lafayette Radio	26, 27, 29
Lektron	117
Lincoln, Martin	134
Micro Electron Tube Co.	129
Milwaukee School of Engineering	30
Modernaphone, Inc.	118
Mosley Electronics, Inc.	139
Moss Electronic, Inc.	3rd, 4th COVER, 148
National Radio Institute	115, 116
National Technical Schools	9
Norelco	12
Olson Radio Corporation	135
Pacific International College	126
Paco Electronics Company, Inc.	22
Palmer, Joe	143
Philadelphia Wireless Technical Institute	136
Picture Tube Outlet	120
Popular Electronics Book Division	141
Popular Electronics Book Division—Citizens Radio Handbook	145
Popular Electronics Dealer Ad	142
Popular Electronics Subscriptions	132
Popular Electronics Upcoming Contents	33
Port Arthur College	142
Progressive "Edu-Kits" Inc.	25
RCA Institutes, Inc.	2nd COVER, 19
Radio Shack Corp.	120
Rad-Tel Tube Co.	39
Rinehart & Co., Inc.	10, 11
Robins Industries Corp.	120
Schober Organ Corp.	119
Sleep-Learning Research Ass'n	132
Sonotone Corp.	133
Sports Cars Illustrated Directory	130
Sprayberry Academy of Radio-Television	35
Springfield Enterprises	136
"TAB"	143
Tech Master Corporation	18
Teletron Electric Co.	31
Texas Crystals	133
Tri-State College	134
Tru-Vac Electric Company	14
U. S. Air Force	3
Valparaiso Technical Institute	128
Vanguard Electronic Labs.	143
Vocaline Company of America, Inc.	16
Walsco Electronics Mfg. Co.	126
Wiley & Sons, Inc., John	140
World Radio Laboratories	123

Asian continent in standard Chinese, Russian, Eng., and Japanese at 0545-0745 on 11,705 and 9525 kc; to the Philippines and Indonesia in Eng. and Indonesian at 0645-0800 on 17,855 and 15,325 kc.; and to S. E. Asia in standard Chinese, Fukienese, Cantonese, French, Thai, Eng., and Japanese at 0800-1100 on 11,705 and 9675 kc. The General Asian Service in Eng. and Japanese is given at 2000-2030, 2200-2300, 0030-0130, and 0500-0530 on 15,135 kc. and at 0700-0930 on 11,940 kc. (*WPE2ASI, WPE2BWA, WPE2LP, WPE4AUW, WPE4FY, WPE4JP, WPE4KB, WPE5AEB, WPE6AFB, WPE8GB, WPE8MS, WPE9AGB, WPE9KM, VE7PE1R, JH, UN*)

Lebanon—Beirut has been tuned from 0216 to 0230 s/off on 8010 kc. in Arabic except for a brief Eng. and French anmt at s/off. This one varies from 8000 kc. to as high as 8025 kc. (*WPEØAE*)

Libya—Benghazi, 9894 kc., is noted at 1215-1255 with Arabic talks and music, and again from 1530 to 1615 s/off. Arabic news is given at 1600. This frequency replaces 7188 kc. and is not an easy one to hear. (*WPE1BM, WPEØAE*)

Monaco—*R. Monte Carlo* has an international request program entitled "Musique Sans Passeport" every Sunday at 1705-1800 on 6035 and 7140 kc., with anmts in Eng., German, Spanish, Italian, Russian, Arabic, Greek, Turkish, and Yiddish. (*WPE2BWA, WRH*)

Nigeria—The West Regional Program, Ibadan, 7285 kc., is strong at 0129 with drum IS, Eng. ID, and pop dance music. The North

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James Silk *(WPE1AGM)*, Madison, Conn.
Bradford Duziel *(WPE1AKZ)*, Lexington, Mass.
Jerry Berg *(WPE1BM)*, W. Hartford, Conn.
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Ken Boord *(WPE8GB)*, Morgantown, W. Va.
Mike Kander *(WPE8MS)*, Dayton, Ohio
Earl Kinmouth *(WPE9AGB)*, Joliet, Ill.
Bob Dritz *(WPE9AOP)*, Chicago, Ill.
A. R. Niblack *(WPE9KM)*, Vincennes, Ind.
John Beaver, Sr. *(WPEØAE)*, Pueblo, Colo.
David Bennett *(VE7PE1R)*, Richmond, B. C.
Edward Colby *(EC)*, Lynn, Mass.
Jim Holzer *(JH)*, Schenectady, N. Y.
Ullrich Noack *(UN)*, Frankfurt-main, West Germany
Charles Sutton *(CS)*, Toledo, Ohio
World Radio Handbook (WRH)

Regional Service, Kaduna, 6174 kc., is audible at 0125 with drum IS, Eng. ID, native music, and BBC news at 0200. The National Program, Lagos, 9533 kc. (formerly 9655 kc.), is noted with drums IS and Eng. ID at 0114 followed by pop dance music. (*WPE3NF*)

Portuguese Guinea—According to the multicolored folding-card verification from CQM, this station operates at 1600-1800 on 7948 kc. with 500 watts. Reports go to Presidente de Comissao, Emissora da Guine, Estacao CQM, Bissau, Guine Portuguesa. (*WPE1BM*)

Sarawak—*R. Sarawak*, Kuching, has moved to 5038 kc. and is noted from 0745 to 0845 with Eng. (news at 0800). The IS is a guitar melody. (*CS*)

Spanish Guinea—Santa Isabel, 7160 kc., has been noted in Spanish from 0730 to 0900, with news at 0815. Listen carefully for either of two ID's: *Aqui Emissora de Radiodiffusion de Santa Isabel, Fernando Po* or *Aqui Transmite Radio Santa Isabel.* (*CS*)

R. Calatrava, Rio Muni, 6668 kc., has been heard weakly closing at 1556 with a rendition of "Ave Maria." Frequency varies to 6678 kc. (*WPE3NF*)

Sudan—Omdurman's new 31-meter outlet is heard on 9545 kc. with Arabic chanting and ID at 1820. The 5038-kc. channel has moved to 5067 kc., s/on at 1815. Arabic news is also carried at 2330. (*WPE3NF, WPE9KM*)

Switzerland—According to the latest schedule from Berne, English is broadcast as follows: to Eastern Australia and New Zealand at 0215-0400 and to Western Australia and the Far East at 0400-0445, both on 21,520, 15,305, and 11,865 kc.; to Southeast Asia and Japan at 0745-0930 on 21,520, 17,784, and 15,305 kc.; to South Africa at 0945-1130 on 21,520 kc.; to India and Pakistan at 0945-1130 on 21,605 and 15,305 kc.; to the Middle East at 1145-1330 on 21,605 and 15,305 kc.; to the British Isles at 1345-1530 on 9665 and 7210 kc.; and to Eastern N. A. at 2030-2115 and Western N. A. at 2315-0000, both on 11,865, 9535, and 6165 kc. Other xmsns include: Spanish and Portuguese to Spain and Portugal at 1545-1730 on 11,865 and 9665 kc., and to Brazil and South America at 1800-1945 on 15,315, 11,865, and 9535 kc.; Spanish only to Central America at 2230-2300 on 15,315, 11,865, and 9535 kc. A European program in German, French, and Italian is transmitted at various times of the day between 0015 (Sunday at 0110) and 1740 on 9535 and 6165 kc.; this program is relayed to Africa at 0015-0200, 0500-0730, and 1130-1740 on 21,520 kc. (*WPE1AGM, WPE1AKZ, WPE2ACO, WPE4ARK, WPE4EB, WPE4FY, WPE6AFB, WPE6AJQ*)

Thailand—HSQ, Pituksuntiradse Radio Station, Bangkok, 4770 kc., was noted weakly at 0700 with a program in Thai. (*WPE3NF*)

Uruguay—*R. Sarandi*, Montevideo, has been heard on CXA60, 15,390 kc., until 2000 s/off, and on CXA68, 11,885 kc., with semi-classical music and a request program at 2100-2130. Both segments were all-Spanish. (*WPE1CU, WPE8MS*)

—30—

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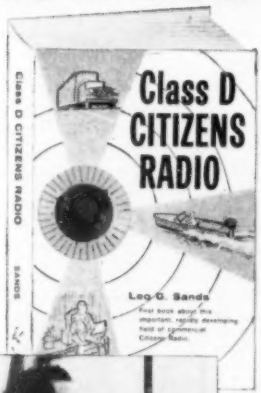

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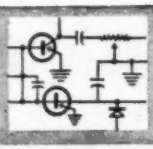

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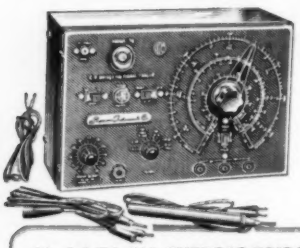

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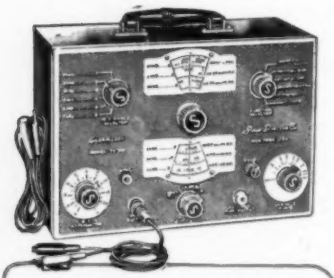

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• **DC VOLTS**—0 to 3/15/75/150/300/ 1,500 volts at 11 megohms input resista • **AC VOLTS (RMS)**—0 to 3/15/75/ 300/750/1,500 volts. • **AC VOLTS** (Pea Peak)—0 to 8/40/200/400/800/2,000 vo • **ELECTRONIC OHMMETER**—0 to 1 ohms/10,000 ohms/100,000 ohms/1 m ohm/10 megohms/100 megohms/1,000 m ohms. • **DECIBELS:** −10 db to + 1 + 10 db to + 38 db, + 30 db to + 5 All based on 0 db = .006 watts (6 mw) a 500 ohm line (1.73v). • **ZERO CEN METER**—For discriminator alignment w full scale range of 0 to 1.5/7.5/37.5/ 150/375/750 volts at 11 megohms input sistance.

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